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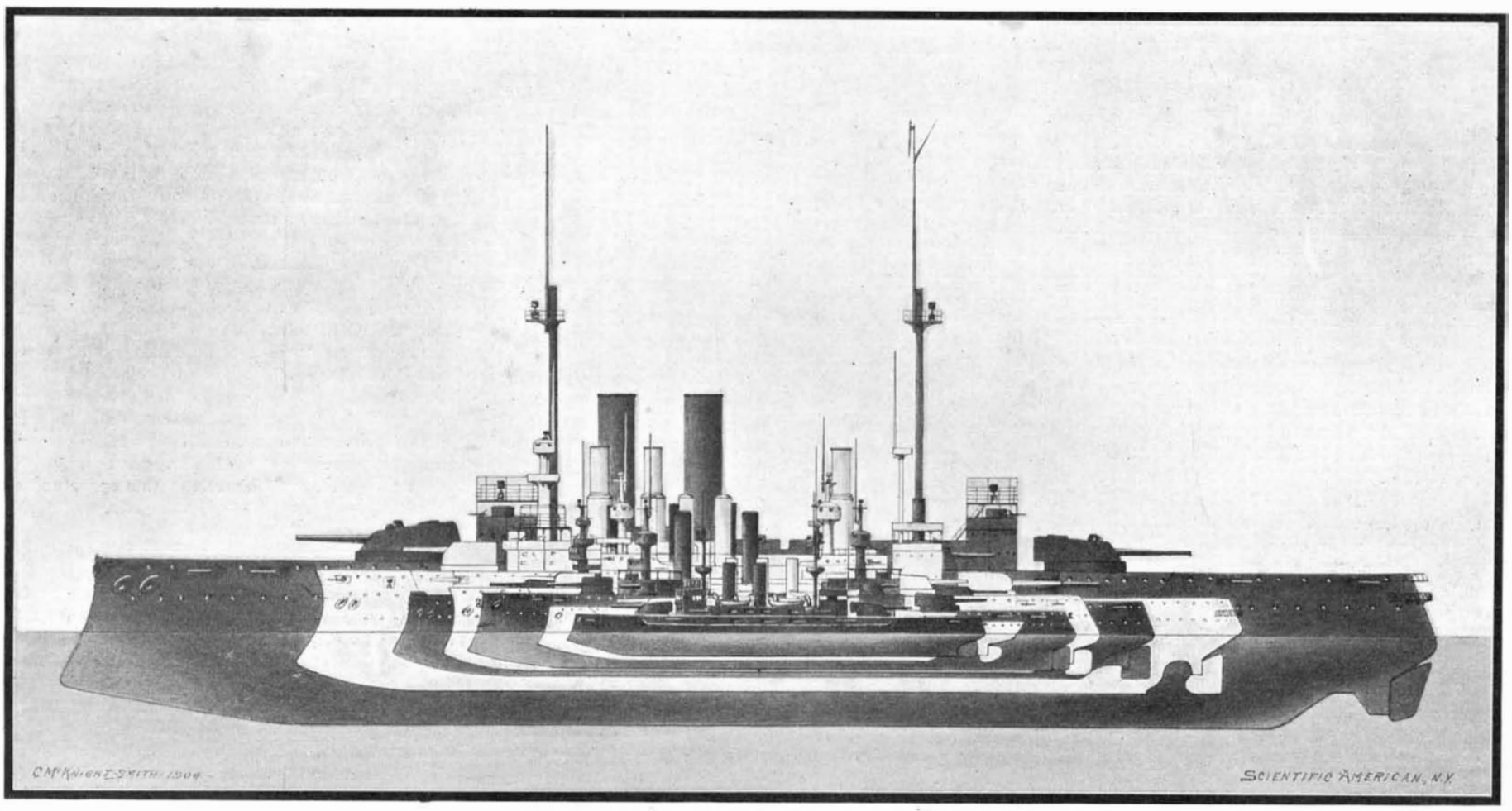
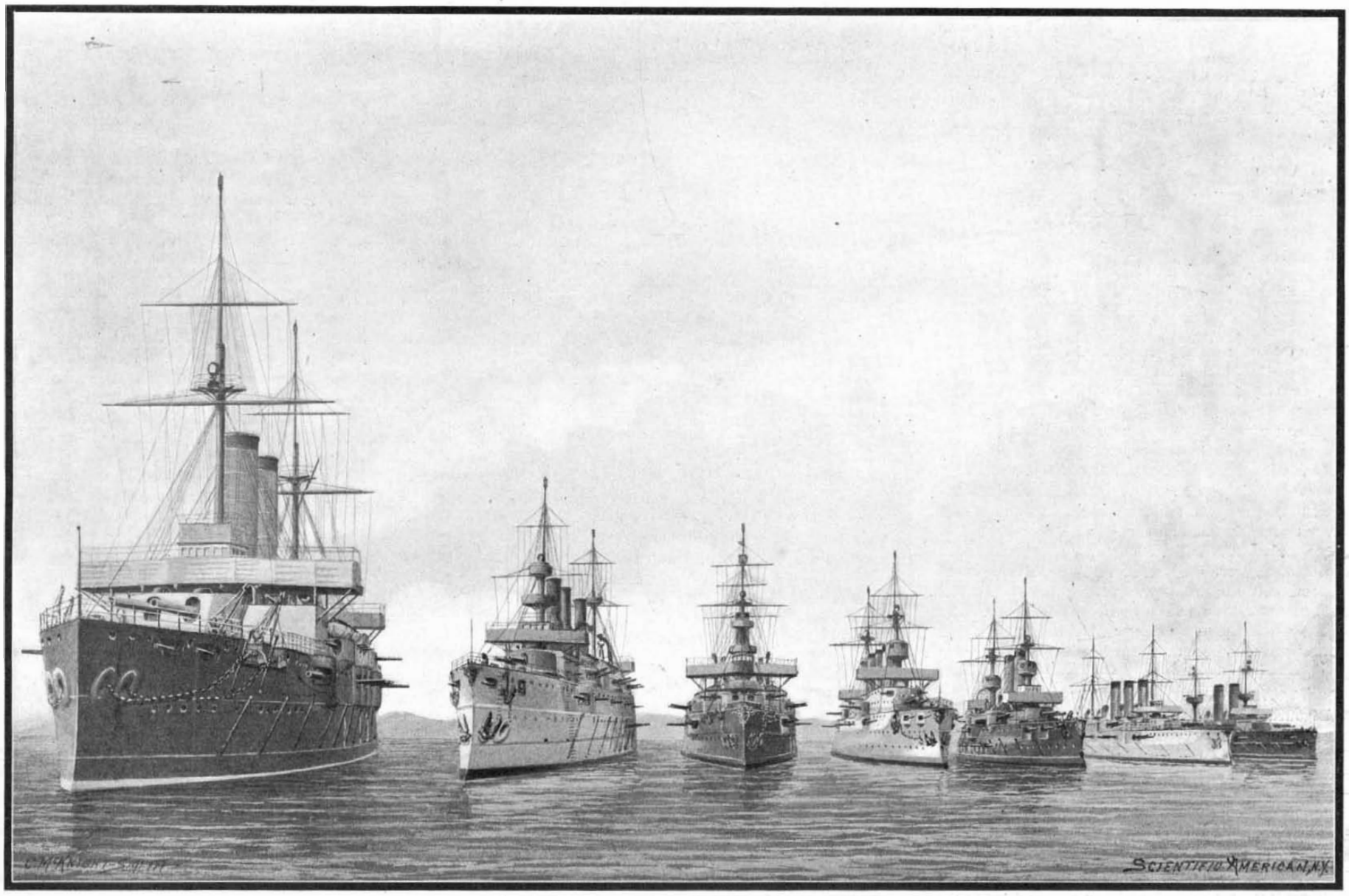


The Relative Strength of the Navies of the World in Warships Built and Under Construction, if the Port Arthur Fleet Were Destroyed.



England,	France,	United States,	Germany,	Russia,	Italy,	Japan,
1,867,250 tons.	755,757 tons.	616,275 tons.	505,619 tons.	488,732 tons.	329,257 tons.	253,681 tons.

Relative Size of Navies Shown, if All Ships Now Under Construction Were Completed, and the Port Arthur Fleet Were Destroyed.

WHAT THE LOSS OF THE PORT ARTHUR FLEET MEANS TO RUSSIA—A DROP TO FIFTH PLACE.—[See page 79.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, JULY 30, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RAILROADS IN SWEDEN TO USE ELECTRIC SYSTEM.

The Swedish government is thinking seriously of using electric traction on the State railroads, the current to be obtained from the numerous waterfalls which are found in that country. To this end Parliament has been asked to vote a large grant for the transformation of the system. Preliminary trials are to be carried out on a section of the Varta railroad, also on a portion of the line running from Stockholm to Jarfra. The current for this purpose will be furnished by the Stockholm central station and from a temporary plant which is to be installed at Tomteboda. Four large electrical firms have already submitted plans for the trial of their systems, the Siemens-Schuckert, Allgemeine, Oerlikon, and English Westinghouse companies. While the movement is taking place in Sweden, the same question has come up in Switzerland, another country possessing large water power. A conference recently held at Berne, in which were represented the government and private railroad lines and also the leading engineers and electrical constructors, appointed a commission which is to make the preliminary investigations and draw up a series of propositions within one year. In Italy, where a number of electric railroads are working successfully, it is now proposed to use electric trains on the Milan-Venice railroad, using the third-rail system which is at present employed on the Milan-Varese line.

RECENT EXCAVATIONS AT CARTHAGE.

M. Gauckler, whose work in the excavations at Carthage is well known, has lately made an interesting discovery, having found one of the most important constructions of the Roman epoch. This is the theatre where Apuleius held his conferences, which is often mentioned by Tertullian and St. Augustine. It seems that the edifice was built at the beginning of the second century A. D., and was afterward destroyed by the Vandals. No exact indications have been given as to the site of the edifice, which was often confounded with the Odeon, recently uncovered near by, and it was supposed to have been entirely destroyed. The present excavations now elucidate this problem. The first trench which was opened in the supposed axis of the theatre proves that the structure is preserved in a fairly complete state, buried under 25 feet of earth, and that its dimensions are colossal. At the present time the excavators are approaching the stage and are beginning to discover the architectural decoration of the latter, with its capitals and cornices. Before long it is hoped to find statues and various ornaments analogous to those which were discovered in 1900 on the site of the Odeon. At present a very fine oval cameo upon agate has been brought to light. It represents the head of Pallas-Athene, bearing a helmet. The head is in white upon a background of pale yellow.

WAVE-OPERATED CLOCKS AT PARIS.

M. Bigourdan has been making experiments in Paris on a system of wave-operated clocks, and proves that such a system can be practically operated and would be of considerable value in a large city. Paris has already a system in which fifteen electric clocks in different parts of the city are connected with the Observatory. But the system is costly on account of laying the wires, and its use is limited. The wave method is cheaper and more practical. A main clock which operates an electric contact each second, works a relay which sends current into the primary of an induction coil provided with an oscillator. The secondary thus gives an oscillatory discharge for a very short time, which is regular for each second. By using a mast, the signals can be sent to the receiving clocks. Two kinds of receivers are used. The simplest is a radio-telephone of the Popoff-Ducretet pattern, in which a beat is heard each second. The second is the receiver of an ordinary wireless telegraph receiver. Better signals are formed by using a chronograph band and pen to replace the ordinary Morse band. With this apparatus, which unrolls one centimeter of band per second, the time can be read within 0.02 seconds. The experiments were made at 1.2 miles distance, and this could easily be increased. To number the seconds the emissions would occur at the zero second of each minute, and an interruption could be made at intervals of 10 seconds. Such a system would be a great convenience for scientific and industrial establishments, watchmakers, and other places where correct time is needed.

THE GREAT SIZE OF THE ST. LOUIS EXPOSITION.

The American people are credited with a love for big things; and if the mere element of bigness were its strongest attraction, the great Exposition at St. Louis ought to be the most popular and successful of the many exhibitions of the kind to which the country has been treated during the past decade. Yet anyone who is present on the grounds, and takes careful note of the vast throngs which are to be found trying to make the round of the two square miles that are devoted to the Exposition, will be forced to the conviction that if the mere size of the Fair is an attraction, it is an attraction that is more of a sentimental than of a practical character; for it must be confessed that for the average visitor, with only limited time at his disposal, the Exposition of 1904 is altogether too big.

Judged from the merely spectacular side, the vast proportions on which this enterprise has been planned and carried out have served their purpose well; for a view of this wonderful congregation of buildings, taken, let us say, from the steps of the great Festival Hall, is certainly as magnificent, beautiful, and artistically impressive as anything that could well be imagined. But when, after giving himself up to the emotions that are aroused by this splendid panorama, the like of which will probably never be seen again, the visitor sets himself resolutely to the work of inspecting the buildings and their exhibits, the conviction is soon borne in upon him that to gain anything more than a cursory glimpse would be a work calling for several weeks, if not months, of study. The problem is particularly serious, if he is desirous of following up only certain lines of exhibits, which may be, and probably are, scattered throughout several different buildings on the grounds. The exhibition palaces themselves are so immense, the distances between them so great, that it is impossible to follow out a line of investigation of this kind consecutively, day after day, without becoming practically exhausted.

Now we say this, not in any spirit of unkindly criticism, but merely to draw attention to the fact that in the endeavor to make an International Fair of this kind represent, by its vast proportions, the extent of the resources, the range of the industries, of the country which it represents, the limits of practical usefulness have been far exceeded. It must already have forced itself upon the sponsors of this exposition that future exhibitions of the kind must be restricted in their dimensions.

The difficulties of adequately seeing the Fair and inspecting in detail the various exhibits, might have been largely reduced if the Intramural Railway System had covered at least four times as much ground as it already does. At present, as actually built, in making the outside circuit of the grounds it covers a total distance of about eight miles; and when we remember that the Exposition grounds, which are in the form of a parallelogram, measure one mile in width by one and three-quarters miles in length, it can be understood that the distances across the main group of buildings, encircled by this road, are necessarily very great. Had intersecting lines of track been run in gridiron fashion through the main plazas and causeways, the problem of transportation would have been greatly simplified. Nor would the presence of these tracks have marred the landscape and architectural effects. So vast are the various plazas and courts, that the presence of the trains would scarcely have been noticed.

To give some idea of the great scale upon which the place is laid out, let us consider one single building, the Palace of Agriculture. The plan of this structure is a parallelogram, which extends in width for five hundred feet and in length for sixteen hundred feet. It contains eight or nine corridors, each sixteen hundred feet in length, crowded each of them on both sides with exhibits, and it is intersected throughout its full length with numerous transverse corridors. This means that anyone wishing to cover the whole field of exhibits within this single building, would have to walk at least three or four miles. The other industrial palaces, though not so large as this, are every one of them of great proportions. Thus the United States Government Building is 250 feet wide by 800 feet long; the Palace of Mines and Metallurgy is over twice that width and of about the same length. Then we have the Palace of Manufactures, 1,200 feet in length by 525 feet in width; the Palace of Varied Industries of the same dimensions; and the Palace of Transportation of the same width, but 1,300 feet in length. And so it runs, each of these buildings containing a covered acreage that would represent a large proportion of the total area that was under roof at the Centennial Exposition at Philadelphia.

To those people for whom the theories of Bellamy have an attraction, the problem of attempting to house 5,000 people in a single hotel within the grounds will present a decidedly interesting study. Of course, nothing of the kind, or even approaching it, has ever before been attempted; and considering the ambitious scale on which the hotel is being run, probably the guests are securing about all they can reasonably ask for. But here again the distances to be traversed become a serious problem, as may be judged from the fact that the writer, on starting out for the day, found that a rainstorm was threatening, and in returning to his room for an umbrella had to cover nearly half a mile of walking before he was back at the main entrance.

However, it must, in all fairness to the management of the fair, be admitted that having once planned it upon such a stupendous scale, they have carried out their work with commendable success. And to those who come to the Exposition with time to study its marvelous assemblage of exhibits, leisurely and with patience, it will yield a fund of information and a marvelous range of sights and sounds and impressions that must prove for many a year to come a subject for pleasant and profitable recollection. The number of Americans that have the means and leisure for foreign travel is at best but a small percentage of our population; and every one of this great majority should, if he be able, avail himself of this opportunity to study this "pocket edition" of the great world in which we live.

NEED OF COTTON-PICKING MACHINES.

The high price of cotton in the past year, with little promise of a return to former low prices, has stimulated unusual inquiry into the causes, and made the question of cotton planting, picking, and manufacturing of paramount importance. The part that machinery has played in the development of our cotton industries in this country has greatly affected conditions that existed half a century ago; but to some extent it has still left untouched the most expensive department of the cotton industry. While machinery has been successfully invented for harvesting and planting nearly all of our other agricultural crops of importance, such as corn, wheat, rye, and many of our fruits and vegetables, the gathering or picking of cotton is still done by hand in the most expensive way.

The harvesting of the cotton crop represents the largest item in the cost of production, and consequently the demand for adequate machinery for doing the picking increases each year in proportion to the advance in prices and the steady increase in consumption. The labor item for harvesting cotton is so large that it would seem reasonable to justify the economic need of slaves as in the old days before the war. The early cotton planters claimed that cotton could not be made a profitable industry without slaves, and to some extent their view was a correct one. Unless machinery could be invented to take the place of the cheap slave labor in the cotton fields, cotton growing either could not prove profitable or the consumers would have to pay higher prices for the commodity.

The latter condition has resulted, and it is doubtful if prices for cotton will ever go down to their former low level until some successful cotton-picking machinery has been invented. In picking and harvesting upland cotton about twenty per cent of the entire cost of production is used up in this one item, while it takes even more for harvesting sea-island cotton. In the harvesting season of cotton in the South, the difficulty of getting sufficient pickers is the one great reason why the acreage is not extended. It is comparatively easy for a cotton grower to raise a good acreage of cotton, but when he comes to consider the question of harvesting it, he stops to consider whether it is wise to increase his responsibilities. Thus a farmer with modern machinery for plowing, harrowing, planting, and cultivating can raise thirty acres of cotton without depending upon hired help; but in the harvesting season he would have to employ four men at least to pick the crop during the harvesting months of fall and early winter. It is often necessary that the crop be picked within a month to secure the best results, and in that event the picking force would have to be more than doubled.

Cotton picking to-day is much what it was a century ago. There has been no gain or improvement in the method. The slave darky of ante-bellum days could pick as many pounds of cotton as the free darky of to-day. A fair average day's work for a picker is about 100 pounds of seed cotton. Allowing 130 days for the harvesting season, each picker working steadily would thus gather 13,000 pounds of seed cotton as his share

of work. In 1903 the total Southern cotton crop amounted to 10,205,073 bales, which was only a slight increase over the average for the past five years. To gather such a crop within the harvesting season of 130 days, it would therefore require 1,088,000 laborers if each one picked his quota of 100 pounds of seed cotton per day. The cost of paying this army of pickers at current market wages in the South would amount to more than 10 per cent of the total value of the whole crop. According to statistics last year the amount paid for picking the crop approximated $70,750,000.

What other crop in the country requires such enormous expenditures for gathering? Not even the tea crop of China and India, where picking is done entirely by hand, equals this stupendous item. The tobacco and sugar-cane crop likewise must be gathered by hand, and no adequate machinery for harvesting them has yet been invented; but in their case nothing like 10 per cent of the total valuation of the crop is expended in the harvesting.

Cotton production is thus limited chiefly by this absence of mechanical appliances for harvesting. Prior to the invention of the cotton gin, the culture of cotton was restricted in the same manner as it is to-day; but immediately after this invention the expansion of the industry was noteworthy. Almost within a decade the industry rose from almost nothing to the leading one of the South. It is not too much to expect that the discovery of a successful cotton-picking machine would almost immediately extend cotton culture so greatly that the world's supply would be doubled, and the price reduced nearly one-half, while the growers would enjoy a degree of prosperity not experienced by them for years.

There have been numerous attempts to invent cotton-picking machines; but all of them have revealed such defects in practical operation that they have not been generally adopted by the growers. Yet it is not clear to inventors that these difficulties are of an insurmountable nature.

Prior to the invention of machinery for extracting cotton-seed oil from the waste cotton-seed, the profits to the growers were far less than at any time in the history of the industry. The cotton-seed compressor and extractor almost immediately gave to the waste product of the cotton farm a new value, which has steadily increased ever since. The cotton-seed oil has been found of use as a substitute for olive oil, linseed oil, lard and even for some illuminating oils. To-day there are over seventy-five crude oil mills engaged in handling cotton-seed oil; nearly eighteen refineries; fifteen cotton ginneries; five mammoth cotton-seed oil compressors; ten soap factories; five cottolene and lard factories, and several fertilizer mixing plants, all dependent upon the cotton-seed for their raw material. The various articles manufactured from the oil or the seed-oil cakes used for fertilizers aggregate a value of over twenty millions of dollars a year.

The utilization of a by-product that creates industries valued at millions of dollars is one of the highest achievements of modern invention of machinery. Agricultural machinery invented for simplifying the work of planting, cultivating, and harvesting of crops has added more to the wealth of the country than all other classes of machinery. The planters, cultivators, and harvesters have doubled and tripled the yield of wheat a dozen times over. The American crop of cereals could not be garnered by hand to-day without enlisting the continuous service of ten million laborers during a good part of the summer and autumn seasons. Fully a seventh of the population of the country would thus be required to gather the grain crop, and the other six-sevenths would probably be needed in doing the other agricultural labors of the country, leaving no one to attend to the manufacturing and commercial pursuits.

Hundreds of millions of dollars are invested in the manufacture of harvesting, planting, and cultivating machinery and implements, and they enable the American farmer to secure more from an acre of land at less cost than he could possibly do without machinery. While intensive farming in the United States has never reached the same development as in parts of Europe, the use of improved agricultural and labor-saving machinery for harvesting and cultivating crops has been carried to a much higher point of efficiency than elsewhere on the globe. It is doubtful if the American farms could much more than feed our own population without modern machinery, and our exports of farm products would immediately cease.

In the future of cotton raising the introduction of machinery for harvesting the crop can alone transform present conditions and increase the present output to any great extent. With the high cost of picking threatening them, the southern cotton growers refuse to increase their acreage beyond a point where they can safely count upon getting the cotton harvested within the limited fall season.

The few cotton-picking machines that have been invented have invariably proved inadequate. To do the work rapidly and thoroughly the machinery must be delicate and almost human in its operation. The fiber of the cotton plant is the wing of the seed, and it is soft and fleecy, ready to be blown away by the wind. To pick this fiber requires expert manipulation of hands that can separate it from the boll without injuring the fiber itself. The gathering of the cotton from the boll with the fingers is not difficult, but to invent machinery to do this is complicated.

Modern improvements of cotton by cultivation and selection have lengthened the staple, and made picking far easier, introducing conditions more favorable for machine harvesters. Thus through plant breeding and selection sea-island cotton of our Southern States has been raised from a common wild plant that seldom matured its seeds, and with a staple less than one inch in length, to handsome plants with fiber from two to three inches in length, and strong and fine as silk. In fact, the finest grades of the improved sea-island cotton plants are used to adulterate silks, and the price they bring in the market is double that paid for the ordinary grades. The influence of breeding and cultivation in making longer fibers has also increased the yield. Some of the heavier grades have been made nearly to double their annual yield, and the amount raised per acre is thus increased.

Thus the cotton problem becomes a mechanical more than an agricultural question. The growers have almost reached the limit of improvement, and science has nearly exhausted methods for increasing the yield chemically and culturally; but the inventor's field is still unexploited, and is waiting for the genius to come and claim a rich reward.—George Ethelbert Walsh.

THE HEAVENS IN AUGUST.

BY HENRY NORRIS RUSSELL, PH.D.

The summer constellations are now well visible, and this is a good month in which to learn to know them.

If we go out at nine o'clock on a clear evening in the middle of August we will see the Milky Way, forming a great arch across the sky and passing almost overhead. Many of the finest constellations in sight lie near it, and we will begin with them.

Near the horizon, a little west of south, is Scorpio, the most brilliant of the twelve zodiacal constellations. Its brightest star, Antares, is fiery red in color, and is accounted the reddest of all the bright stars. A fainter white star flanks it on each side. The vertical row of three stars on the right makes the Scorpion's head and claws, while its tail is formed by the long line of stars which descends from Antares almost to the horizon, and curves back to the end in a bright group, which is conspicuous even at the low altitude at which we see it.

Antares is doubly worthy of attention by those who possess telescopes, as in addition to its splendid color and fine banded spectrum, it is double, having a green companion of the seventh magnitude at a distance of about three seconds. On account of its nearness to the principal star, it can be well seen only when the air is steady.

To the left of Scorpio lies Sagittarius, whose principal configuration is the little inverted "Milk Dipper," composed of five fairly bright stars. Above it the Milky Way is full of bright patches and knots, which afford many fine telescopic fields. Some of the star clusters and nebulæ in this region are distinctly visible in a field-glass.

The bright star higher up, almost on the central line of the Milky Way, is Altair in Aquila. It is one of the nearest of the brighter stars, coming next to Sirius and Procyon in order of distance. The next constellation to the north of Aquila is Cygnus, which is easily identified by the fine cross of stars whose axis lies along the Galaxy. West of Cygnus, and almost overhead, is Lyra, whose principal star, Vega, is the brightest in this part of the sky. The region east of the Milky Way is not so brilliant. The most prominent group is the great square of Pegasus, which is now about an hour high in the east. The constellation is a large one, and extends westward from the square half way to Altair, leaving room between them for the little group of Delphinus.

Aquarius and Capricornus, which are lower down in the southeast, have no very bright stars, but Saturn, which is now in the latter constellation, is decidedly conspicuous. The brightest star in the western sky is Arcturus, which is almost due west, and about half way down to the horizon. The rest of Boötes lies north and east of it. A line from Arcturus to Vega passes first through the semicircle of Corona Borealis, and then through the keystone-shaped figure which is the most recognizable feature of Hercules, whose other stars extend some distance both north and south. Farther down between Hercules, Aquila, Scorpio, and Boötes a large space is filled by Ophiucus and Serpens—two constellations which are so inextricably confused that one must use a star-map to tell which stars belong to each.

Of the circumpolar constellations Ursa Major is in the northwest, to the left of the pole. The fore-parts of the Bear are too low to be well seen, but the Dipper is still conspicuous.

Draco lies above Ursa Major, extending to the meridian. The Dragon's head is marked by a conspicuous group of four stars about one-third of the way from Vega toward the Dipper. His body extends first eastward, then northward, and then bends back in a long curve, inclosing the Little Bear, so that the end of his tail lies between the Pointers and the Pole Star.

Cassiopeia and Cepheus lie in the Milky Way on the other side of the Pole, and Andromeda and Perseus are rising in the northeast.

THE PLANETS.

Mercury is evening star throughout August, and is visible in the evening twilight for most of the month. On the 1st he is close to the bright star Regulus. The two set at about 8 P. M., so they will not be easy to see. Later on the planet is more easily visible. He reaches his greatest elongation on the 19th, when he is more than 27 deg. from the sun—about as far as he ever can be, as seen from the earth. He is, however, some 10 deg. farther south than the sun, and is consequently not as conspicuous as he was in the spring. But as he sets an hour later than the sun all through the middle of the month, he ought to be seen without much difficulty. Venus is also morning star, but is still too near the sun to be visible to the naked eye.

Mars is morning star in Gemini and rises about two hours before the sun. On the 12th he is nearly in line with the two bright stars, Castor and Pollux, which may aid in finding him.

Jupiter is in Pisces and will soon be conspicuous in the evening sky. He rises before 10 P. M. on the 15th, and is well observable after midnight. Transits of his satellites may be seen on the nights of the 2d, 7th, 9th, 14th, 16th, 18th, 23d, 25th, and 30th.

Saturn is in opposition on the 10th, and is visible all night long. He is better placed for observation than he has been for several years, though he is still a good way south of the equator. He is in Capricornus, a long distance from any bright star, so that he can hardly be mistaken for anything else.

His rings are seen more nearly edgewise than in the last few years, and consequently appear narrower, so that the ball of the planet projects conspicuously beyond them at each side. The apparent orbits of his satellites are also becoming narrower, for the same reason. The fainter of these interesting bodies can only be seen with large telescopes, but the brightest one, Titan, is easily visible with a small instrument. It may aid in identifying him to know that he is north of the planet on the 3d, east on the 7th, south on the 11th, and west on the 15th, the positions repeating themselves regularly in the satellite's period of 16 days.

When north or south of Saturn his apparent distance from the planet is about equal to the greatest diameter of the rings, but when east or west of him it is about four times as great.

Uranus is evening star in Sagittarius. His position on the 15th is R. A. 17 h. 43 m., dec. 23 deg. 36 min. south. He is not near any conspicuous star, but if his place is plotted on a star-map, he can easily be found.

Neptune is morning star in Gemini, and rises at about 2 A. M. in the middle of the month.

THE MOON.

Last quarter occurs at 9 A. M. on the 4th, new moon at 8 A. M. on the 11th, first quarter at 11 P. M. on the 17th, and full moon at 8 P. M. on the 25th. The moon is nearest us on the 12th and farthest away on the 26th. She is in conjunction with Jupiter on the 3d, Neptune on the 8th, Mars on the 9th, Venus on the 12th, Mercury on the 13th, Uranus on the 20th, Saturn on the 24th, and Jupiter again on the 30th. None of the visible conjunctions is close.

An occultation of the fourth-magnitude star Gamma Tauri, which takes place early on the morning of the 6th, is visible in the eastern part of the United States. As seen from Washington, the star disappears behind the moon's bright limb at 1.56 A. M. and reappears from behind the dark limb at 2.55.

The times of the phenomena will vary for different places, being in general earlier for places farther west.

Cambridge, England.

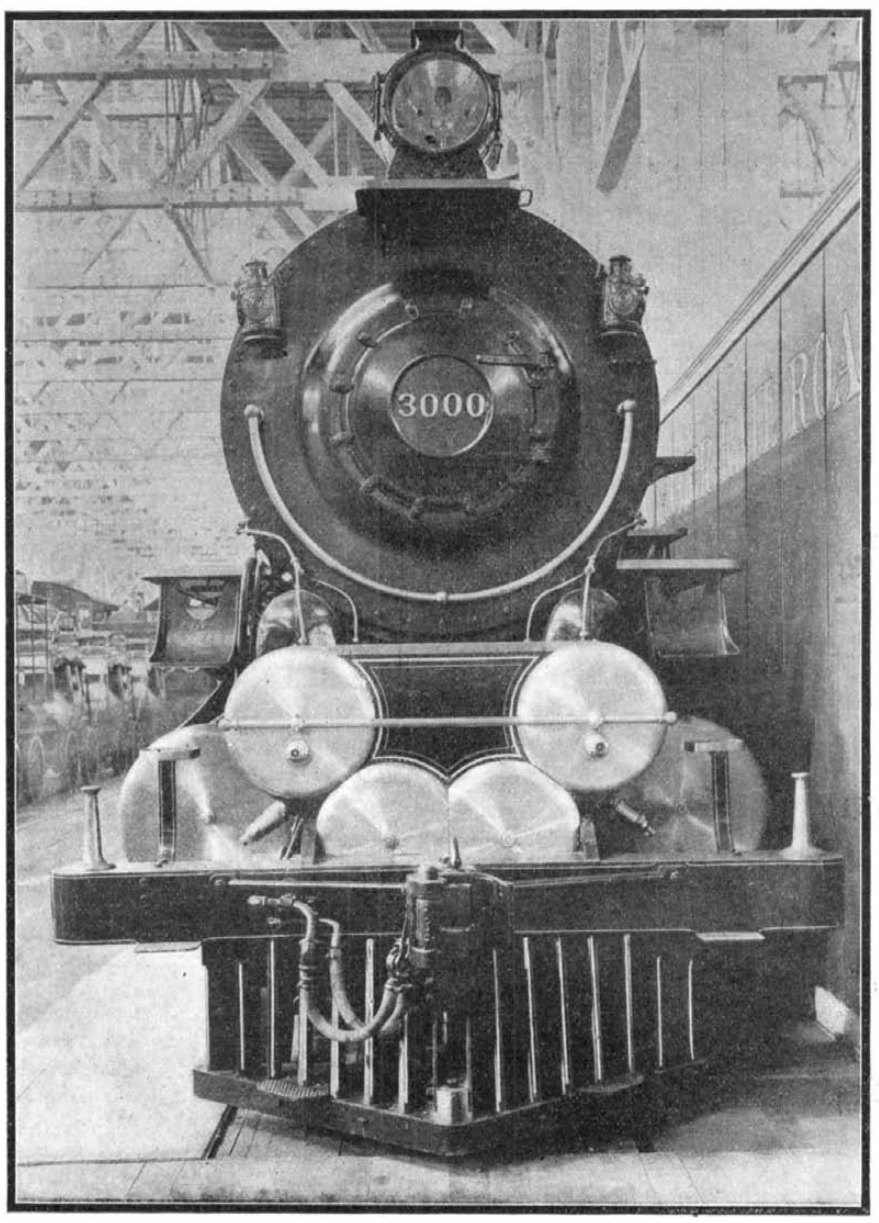
The Michigan Central Railroad officials have for some time been considering the proposition of bridging the Detroit River at Detroit, Mich., but it is said that there is a strong possibility that these plans will be entirely abandoned, and the crossing effected by tunnel. Representatives of the company have been investigating the tunnel work around New York, and a careful examination of the Detroit River bed is now being made; and if the reports are as favorable as anticipated, the work will probably be commenced at an early date. The work is authorized by charters which have already been secured from the United States and Canadian governments. It is said that the tunnel route has many excellent features to recommend it.

NEW YORK CENTRAL EXPRESS COMPOUND LOCOMOTIVE.

BY THE ST. LOUIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

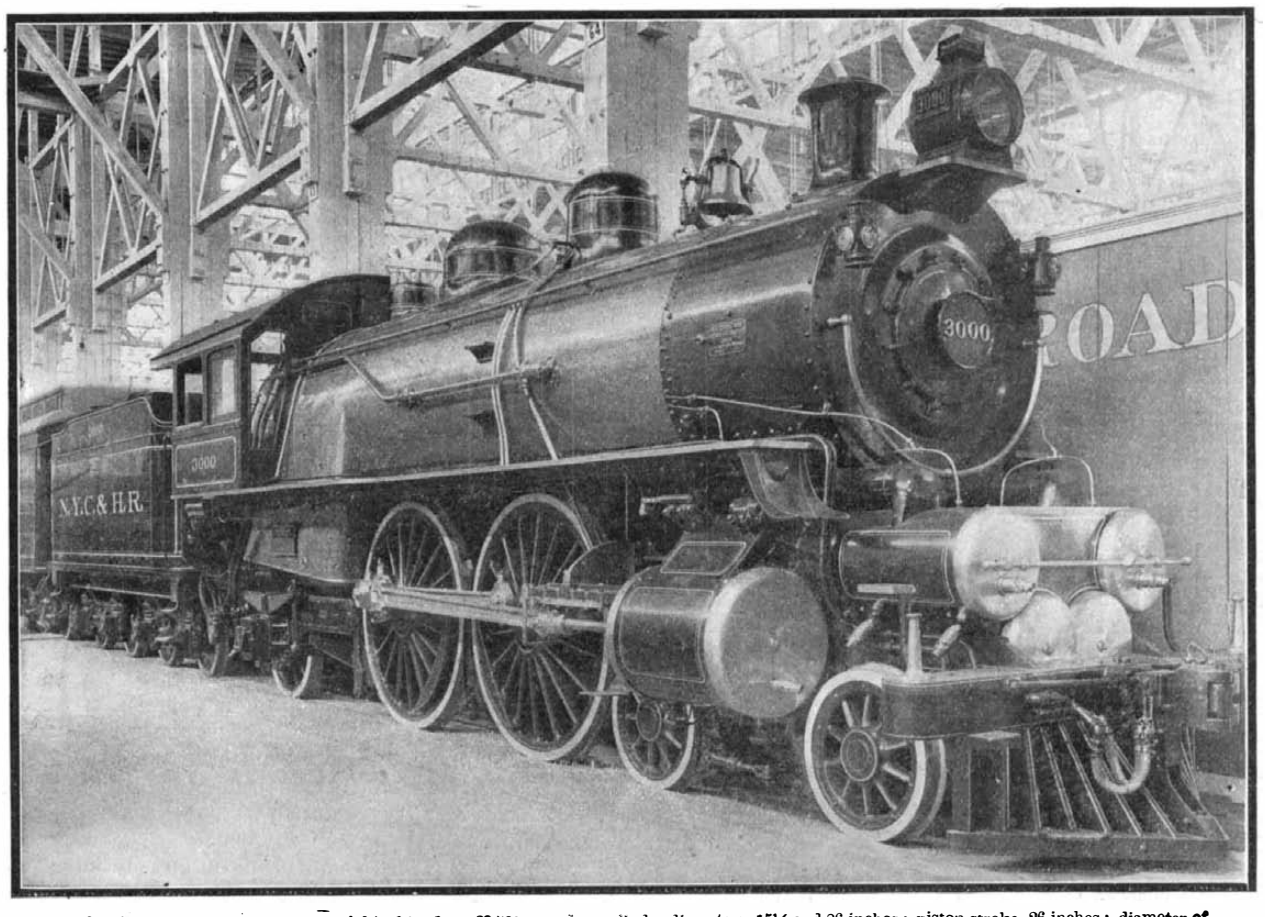
The feature of the New York Central exhibit in the Transportation Building of the St. Louis Exposition is a complete train of the Empire State Express type, consisting of an engine and four cars of the type which has helped to give this train its well-earned reputation. For the past two or three years, the Empire State and indeed all the fast expresses of the New York Central have been hauled by the new Atlantic type of simple engine, which the company brought out specially for this class of work. It was upon one of these engines that the editor of the SCIENTIFIC AMERICAN made a considerable part of a trip from New York to Chicago and back on the Twentieth Century Limited some eighteen months ago, the account of which trip was given in our special transportation number of Dec. 13, 1902. Reference is made to that article for the performance of those engines. The best work was done on a run with a six-car train weighing 360 tons, from Albany to Spuyten Duyvil, 131½ miles in 130 minutes. The new compound engine conforms rather closely in its general outlines, and in its leading proportions, weights, etc., to these Atlantic engines, the chief and very important difference being that four cylinders working compound are used instead of the two 21½-inch simple cylinders of the older type.

The leading dimensions of the new engine are as follows: The high-pressure cylinders are 15½ inches diameter by 26 inches stroke; the low-pressure cylinders, 26 inches diameter by 26 inches stroke. The boiler is 72½ inches in diameter, and its 390 tubes have a heating surface of 3,248.1 square feet; its firebox has 175 square feet and arch 23 feet, the total for the whole boiler being 3,446.1 square feet. The driving wheels are 79 inches in diameter and are coupled, and the total weight on the drivers is 110,000 pounds. The arrangement of the engine is as follows: There are two high-pressure cylinders, located just forward of the saddle, which connect to a pair of cranks in the axle of the leading pair of driving wheels. Outside the frames, and occupying the usual position abreast of the saddle, are the two low-pressure cylinders, and these connect to the rear pair of driving wheels. This is a distribution of the work which is good in principle, and has proved to be excellent in practice. It divides the stresses between the two axles, and facilitates the work of counterbalancing. So well has this problem been worked out that, in the trying-out service to which the engine was subjected for several weeks before being sent to the Fair, she proved to be by far the most steady-running engine that was ever handled by the New York Central engineers; and she has naturally aroused in them a considerable degree of enthusiasm. Two of the records which she has made are well worthy of being noted here. On one occasion, when hauling four Pullman cars between Syracuse and Buffalo, she covered twelve miles of level track at an average speed of 84 miles per hour; and on another occasion, with six Pullman cars, on the same division between Syracuse and Buffalo, she covered a distance of 69 miles, on practically level track, at a speed of slightly under 80 miles per hour. The four cylinders are provided with only two pairs of eccentrics and their accompanying gear, there being one set actuating a single piston valve for each pair of high and low-pressure cylinders on either side. The piston-valve cylinders are carried forward of the saddle above the low-pressure cylinders. In spite of the heavy work to which the engine was put in the working-out trials, she proved to be easy to fire, and the full steam pressure of 225 pounds to the square inch was easily maintained when she was being pushed to her full capacity.



Height of stack above rail, 14 feet 10 inches; width, 10 feet; length over all, 62 feet 2¾ inches; maximum tractive power, 27,500 pounds.

FRONT VIEW OF THE EMPIRE STATE EXPRESS BALANCED COMPOUND LOCOMOTIVE AT ST. LOUIS, SHOWING HEADS OF THE HIGH AND LOW PRESSURE CYLINDERS.



Weight of engine, 200,000 pounds; weight of tender, 122,500 pounds; cylinder diameters, 15½ and 26 inches; piston stroke, 26 inches; diameter of driving wheels, 79 inches; working pressure, 220 pounds per square inch; total heating surface, 3,446.1 square feet.

THE BALANCED COMPOUND LOCOMOTIVE AT THE HEAD OF THE EMPIRE STATE EXPRESS, EXHIBITED AT THE EXPOSITION ST. LOUIS.

Radium and How to Test It.

BY PROF. W. LASCELLES-SCOTT.

In consequence of the extremely minute proportion of this remarkable element—if it be an element—present in any mineral as yet known, and the difficulty of extracting and purifying that little in a satisfactory manner, the cost of metallic radium is very great. Unless more abundant sources of supply are opened out, the price—frequently some scores of dollars per grain—is not likely to diminish very speedily. Probably less than a ton, were it obtainable at all, would suffice, "at latest quotations," to extinguish both the American and the British national debts, and leave enough to pay all our taxes for a year or two into the bargain.

High as the price is, the demand is still greater, not only for scientific purposes and as a popular technical "toy" or curiosity, but also for medical and surgical applications of importance. Radium compounds, too—a trifle less costly than the metal itself—are eagerly purchased, and tubes containing a single particle of the "bromide" or "nitrate," etc., more or less impure, generally find a ready sale here at $5, $20, or $50 apiece. These tubes, or rather their contents, however, vary greatly in radio-activity, and they should, if practicable before the purchase is actually completed, be carefully tested in several ways.

The most energetic specimens of radium bromide are of a light orange-brown tint, those of a faint canary or other very pale hue being less powerfully radiant. Placed in close proximity to a tiny crystal of barium platino-cyanide, or, better, a fluorescent "screen" of this salt, it should render the latter brilliantly luminous (in the dark, of course), and, with suitable objects, give "radiograph" or 'skiagraph" effects very distinctly.

Fixed above a thin, perforated sheet of lead lying just over a smooth surface of sodium chloride (common salt) previously made slightly damp with hydrochloric acid, an hour's "exposure" should suffice to darken the salt's white surface to a fawn shade wherever the perforations in the lead have allowed the rays to pass.

Crystals of uranium nitrate, uranium glass, and pieces of white blotting-paper (or of chalk or plaster of Paris) soaked with a solution of quinine bi-sulphate, should be luminously excited on being held near the radium bromide.

Surfaces of zinc-sulphide, especially if viewed through the lens of a Crookes spinthariscope, should exhibit a scintillating glow-light on approaching the radium tube.

Lastly, this latter, its radio-active properties having been optically and photometrically tested, should have these increased by quite 20 per cent after exposure to the "magnetic field" of a good (4-inch to 8-inch spark) induction coil for about half an hour.

The new main shaft of the Waihi gold mine in New Zealand was sunk 83 feet in 18 days. The shaft is 32 feet long by 8 feet wide, and is timbered with 9-inch square sets, with lagging. The depth referred to was from 20 to 103 feet from surface, the shallowness being favorable to speed of sinking.

AUTOMOBILE STREET SPRINKLER.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The city of Paris is now using an automatic street sprinkler of improved design. It is intended to be used on some of the main avenues, where a rapid and effective method of sprinkling has long been desired. The automobile sprinkler has now been in use for some time and has proved quite satisfactory, being much superior to the horse sprinklers which are generally employed throughout the city.

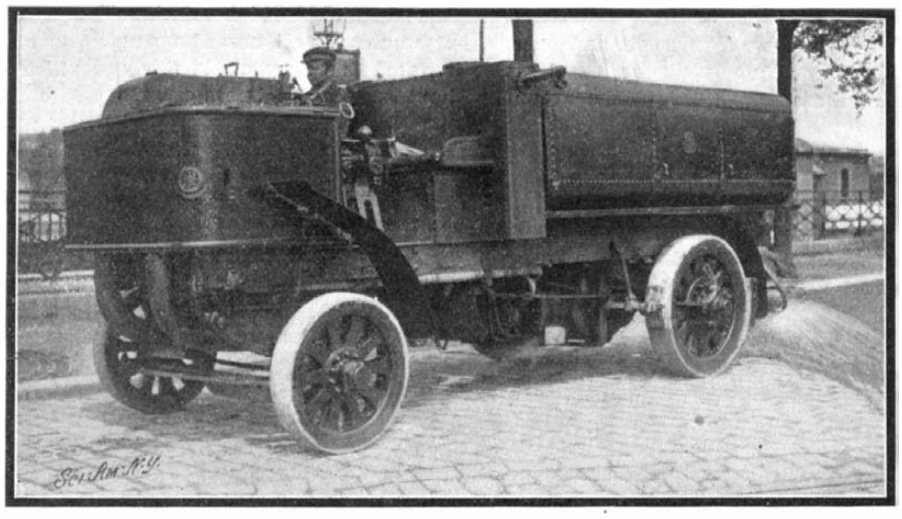
The new car which is shown in the different engravings is a steam tractor of the De Dion type having a 35-horse-power steam engine. It is equipped with a centrally-heated tubular boiler, placed on the front of the chassis. In the central part of the chassis is mounted a horizontal compound steam engine. The movement is transmitted to the rear axle by a universally jointed shaft with bevel gear drive at the differential, somewhat as in the smaller automobiles. The water tank, boiler, and all the controlling apparatus are placed in the front of the car, while the rear platform has mounted on it a large water reservoir of 5 tons capacity for the sprinkling device. This water tank is arranged so that it can be removed from the chassis, which allows the car to be used as an ordinary tractor or hauling wagon, thus increasing its sphere of usefulness.

The distance between axles is 10 feet, 10 inches; and the track is 6 feet. The front and rear wheels are 40 and 50 inches in diameter respectively. The rear platform is 4 feet, 8 inches from the ground. When complete, the sprinkler weighs 6 tons, including the water tank, and the speed varies from 5 to 7 miles an hour. The best speed for watering the streets has been found to be 5.4 miles an hour, and the car is now regulated to run at this speed.

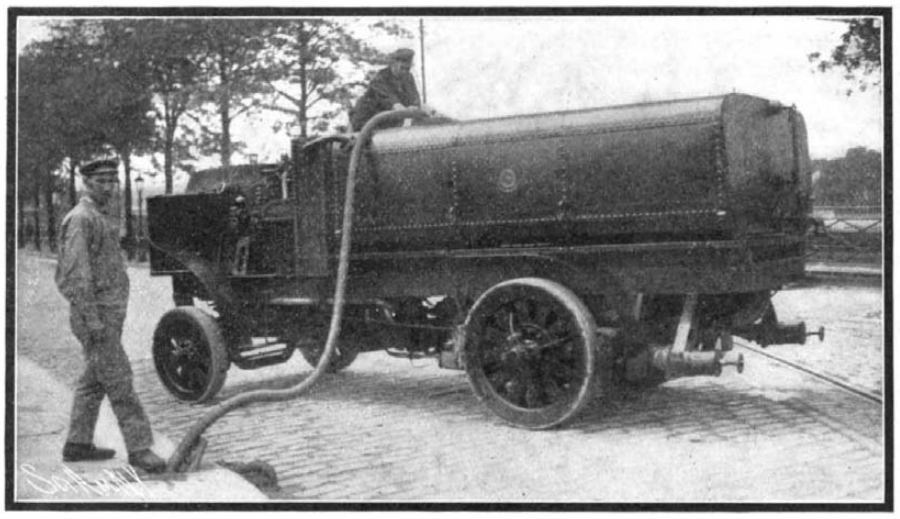
The mechanism of the sprinkler has been well designed. The water reservoir for the boiler, which is built of steel plate, connects with the main water tank, and both are filled by the same operation. The water passes from the main tank through a small pipe to a centrifugal pump, which lies underneath and behind the rear axle. A chain and sprocket transmission drives the pump from the rear axle of the car at a speed which is always proportional to that of the driving wheels. As the car travels at the uniform speed of 5.4 miles an hour, the speed of the pump is kept constant. A cone friction-clutch enables the driver to throw on the pump for operating the sprinkler when the car arrives on the spot, and the reversal of the lever throws it off and stops the water stream. A valve is disposed beside the pump, so that in case of need, all the water delivered by the pump can be returned direct to the tank through a suitable pipe. By operating this valve, the driver can make different combinations according to the position of the lever. Thus the water can be sent into the two sprinkling nozzles, or it can be returned to the tank when the sprinkling is stopped. Means are also provided to use only one of the sprinklers at a time. In the latter case the surplus water is returned to the tank through a pipe which, however, has only a narrow passage for the water, so that the pressure shall not fall below the proper limit.

The sprinkling nozzles have been constructed on a new design. The water arrives through a pipe and flows over an inclined plate, from which it spreads in sheets and falls into a semi-cylindrical chamber, whence it escapes by a set of holes in the sides. A screw, operated from the outside by a hand-wheel, regulates the amount of sprinkling. A piston, operated from the hand-wheel, is moved forward or back and the total section of the water orifices is made to correspond once for all to the pressure obtained by the pump, given the width of sprinkling which is required. To work such a car successfully, the above elements had to be combined with the speed when on the road and the volume of water needed to cover a square yard of ground.

This has been well carried out in the present case, and it is found a practical and economical apparatus. The water comes out in two symmetrical sheets 23 feet wide, and it thus sprinkles a surface 46 feet wide. On the other hand, the 1,250 gallons which the tank contains will water a distance of 0.6 mile. This gives the car a sprinkling capacity of about 1,700 square yards, and this can be covered in a quarter of an hour.



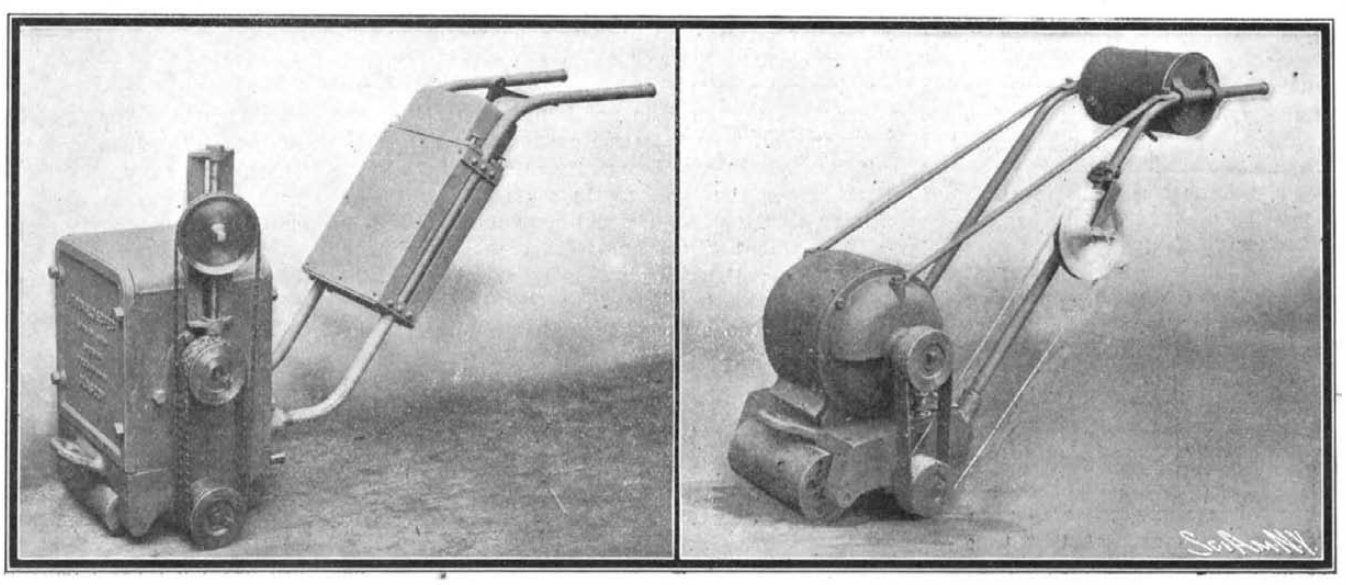
THE AUTOMOBILE SPRINKLER UNDER WAY.



FILLING UP THE TANK OF THE AUTOMOBILE STREET SPRINKLER.

PLANING MACHINE FOR SHIPS' DECKS.

The accompanying illustrations show a ship's deck planing machine for planing the decks of ships, constructed by Mavor & Coulson, of Glasgow. It is actuated by a continuous current, or triphase current, motor. The planing of a ship's deck is one of the most fatiguing and disagreeable kinds of work that a ship's carpenter is called upon to perform, and it is for facilitating such work and doing it more economically that the electric planing machine has been devised. The machine is provided with a triphase motor of 4 horse-power that makes 3,000 revolutions a minute, and actuates the blades with the same velocity. Under ordinary circumstances, the machine planes 360 square feet an hour. The force necessary to operate it consists of a man to guide it, an apprentice to draw it, and another apprentice to sweep up the shavings. In England, the total expense for this labor is 25 cents an hour. By manual labor a carpenter can plane scarcely more than 45 square feet a day, and this represents an expense of $2.50. The machine therefore performs in one hour, and at an expense of 25 cents, the work of eight men for one day at an expense of $20. Upon a ship of medium size, the saving effected by the use of this machine for the planing of a deck is about $400.



A PLANING MACHINE FOR SHIPS' DECKS.

Curious Burial Relics of the Ancient Egyptians.

The excavations which were commenced at Beniasan, on the east bank of the Nile, some two hundred miles above Cairo, in December, 1902, have now been completed. There have been discovered and searched in the necropolis extending along the face of the limestone cliff, 887 tombs, including that of Sebek Hetepa, 2300 B. C., together with its curious funeral models. Each burial chamber was formed of a recess at the base of a square shaft, occasionally at a depth of thirty feet, hewn in the solid rock and carefully filled in. By this careful means the body of the deceased was preserved from disturbance. This type of burial antedates the mummification period; but it was found in the case of two bodies that decay had been arrested by the wrappings, which were found still intact. Each tomb contained a wooden sarcophagus, with the lines of religious formulæ and text inscribed upon it in the orthodox hieroglyphics, and with the head pointing to the north and the painted "eyes of Osiris" toward the east. The sarcophagus was surrounded with a large number of little wooden models representing river and sailing boats, a granary, group of persons baking, a man brewing, a man leading an ox, a girl carrying a brace of birds in her hands and a basket on her head. Notwithstanding the extreme age—four thousand years—of these curious relics, they were found to be in a remarkable state of preservation, the oarsmen in the galleys leaning upon their oars intact, and the paint still bright and clean. The ceremonies attending the interment of a woman were slightly dissimilar, the departed lady being provided with a basket of toilet requisites. These curious little models were buried in accordance with the ancient Egyptian religious rites, in order to provide the departed one with the necessaries for their future life. One highly interesting discovery was made in the course of these excavations—an exact counterpart of the modern weaving reed as used in the mills at Wigan (England), the only difference being that the ancient Egyptians of 2300 B. C. used cane teeth instead of steel.

Safety Device for Handling Plate Glass.

After a piece of plate glass has been formed in the casting room of the factory, it is the custom to remove it by the combined efforts of a gang of men. Sometimes, owing to a defect, which may not be noticeable except under the closest scrutiny, the glass collapses while it is being thus transported and such an accident generally results in the death or injury of one or more of the men engaged in the transportation of the big sheet. By means of a new invention which has been made by two workmen, Oscar Lewellen and John H. Schuck, of Kokomo, Ind., these plates will in the future be carried from the casting house by means of a machine which will not only do the work more quickly but be the means of saving the lives of many men which were formerly risked every time it was necessary to move one of these great pieces of glass. By the new device referred to, the plate will be lifted by pneumatic pressure, and it is designed by the inventors to equip a plant with such an installation that the plate will be carried through all of the various processes by this mechanical means and it will never be necessary to handle it by human effort.

Correspondence.

Mosquito Extermination.

To the Editor of the Scientific American:

I note in your issue of the 9th, under the heading "The Progress of Mosquito Extermination," that "it follows that the *only* remedy is to prevent the production of the pest." Is this true? No doubt if the malarial mosquito could be exterminated there would be an end to the propagation of malaria through this means, but it is not claimed, I understand, that the mosquito can, of itself, propagate the disease. It must first have had access to an infected person. Would it therefore not be much easier to protect the patient from the mosquito than to exterminate hordes of the latter? R. W. Burns.

Great Falls, Montana, July 12, 1904.

Myth of the Catalpa Tree.

To the Editor of the Scientific American:

During the past few years I have occasionally read with much interest articles in different publications concerning the wonderful value of this tree, and the great profits that will be derived from its propagation. While it is one of the finest shade trees, owing to its dense foliage of large leaves, frequently the size of a palm-leaf fan, and its great bunches of beautiful delicate-colored blossoms, I doubt the advisability of growing them for revenue.

I have two of them in my home lot; the oldest was planted fifty-one years ago, and the other is twenty-six years old. The former now measures five feet eight inches in circumference, equivalent to twenty-two and one-half inches in diameter, and nine feet to the lowest limb, above which it branches out in the most irregular shapes; the latter is thirteen and one-half inches in diameter, and seven feet to the first limb. This shows only an average annual increase in diameter of one-half inch, instead of double this amount, as quoted recently by a prominent aboriculturist, who must have been dreaming, as our most rapid-growing trees, the willow and cottonwood, do not come up to such a rating.

In my yard I also have a walnut tree of about the same age and size of the youngest catalpa, which confirms my claim of the slow growth of the latter. My life has been spent in the States of Illinois, Indiana, and Missouri, where these trees are indigenous, and when a boy I have smoked their pods until my tongue was blistered, but never saw one that would make a telegraph or telephone pole, as claimed by the above-mentioned authority, owing to the crookedness above the lower limbs.

From these facts they can only be used for fence posts and railroad ties, as the slight variation in the color of their grain does not fit them for natural finished woodwork. Now let us figure out the profits for growing them for these purposes. My fifty-one-year-old tree will make two railroad ties, worth forty cents each hewed and delivered, more than one-half of which is covered by the cost of the labor, so my two catalpas, if used for that purpose, would net me about fifty cents. They might have been sold at ten cents each for six-inch fence posts when twelve years old.

You can grow these trees less than twenty feet apart, or one hundred to the acre, which in twelve years will bring you a total of ten dollars for fence posts. For railroad ties you can plant sixty trees to the acre, worth after eighteen years about eleven dollars. After liberal allowance for the limbs for fuel, anyone can see the same amount of land put in grain will pay a much greater net profit.

About seventeen years ago an enterprising person planted twenty acres in catalpa trees in a most favorable location on the Mississippi River bottom lands, about twelve miles north of Hannibal, Mo., adjoining our railroad. I have ridden by this field frequently, and watched this experiment with much interest. He has recently sold his trees for fence posts, the returns of which paid him a little more than his taxes. If he had planted in corn annually, he could have made two thousand dollars net profit. S. E. Worrell.

Are Pressmen Affected by Electricity from the Belts?

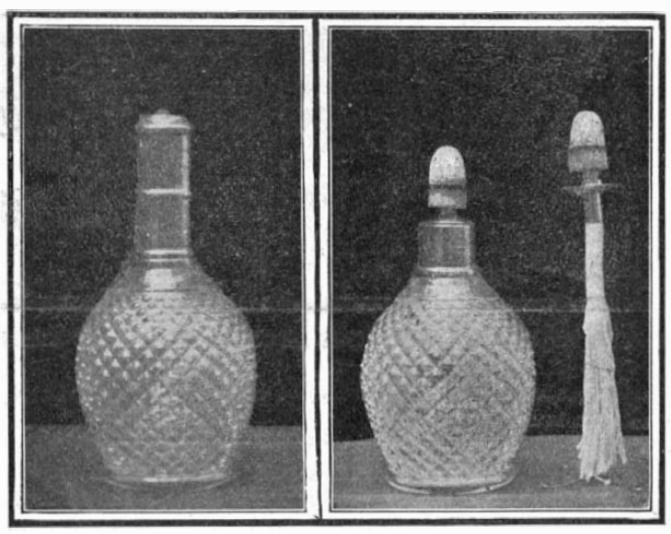
To the Editor of the Scientific American:

I have given a good deal of thought during the past few years to a subject which I have had the intention for some time past of writing to you about. We are engaged in the printing and publishing business, and we have a pressroom in which electricity is the motive power used. I have noted through a series of years the continual sapping of the nerve energy that seems to be in process among the young men who operate the presses.

I have particularly in mind a young man who came to work for us about four years ago, at that time about twenty years of age, who worked with us for four years, and we considered him very dexterous and a rapid worker, but during the time that he was with us his health suffered and slowly and gradually declined, until the past year he seemed barely able to keep at his day's task. Two months ago he left our employment and went to Boston, where he took up composition instead of presswork, and I was struck upon seeing him four weeks later with the marked improvement in the color of his complexion and the brightness of his eye in so very short a time. He is a very temperate young man, of good habits, and the decline I speak of I am sure could not be attributed to outside excess.

We have had other men, strong and healthy, with a good firm grip on their nerves, who would not decline in spirit and energy, but would get all nerved up at their work and get so irritated that they would fairly kick things around without seeming to know exactly what they were mad about. Another young man I recall was so sick at the stomach upon starting on the work that he could not stand up to the press and it has been an unfailing observation of mine that everyone who has worked at our presses has been affected in their health or their grip on their nerves, and I have wondered if it were not the electricity that had a great deal to do with it. One thing that has contributed to an affirmation of this thought is that the atmosphere always seems to be hot and surcharged so as to induce a sort of feverish feeling about the temples, and whenever one approaches near to the belts the electrical attraction will pull at the hair and make it stand out straight in their direction. If one just pass near them in a hurry a prickly sensation will be felt on the skin of the hand as it swings past, and if the finger be held on the belt a stream of actual electrical fire or animal magnetism will shoot from the finger to the belt.

Another thing that has impressed me quite strongly was this: On two different occasions on a holiday I myself have been down to the office to run off some little card or something of a private nature for my wife or myself, and my wife has come down with me for company. She has a highly sensitive nervous temperament. Both times she took a chair and came out to be near where I was at work. But both times she got up and went off to an adjoining proofreader's room. Both times I urged that she come back and be near where I was, but she replied: "No; I think I'll stay in here." Upon further urging she replied: "No; I don't like to sit out there." I asked why, and she replied: "I don't know why, but I don't *like it* out there." Having practically this same conversation with her both times, it made quite a strong impression on me.



BERGER DISINFECTING LAMP.

I do not believe the electrical power is good for one's nerves and health, but I know that in factories where steam power is used there is very much the same electrical feeling to the atmosphere and the pulleys have electrical attraction in the same way, but this makes me also think of a further fact that I am familiar with, though I do not know what the scientific explanation of it is. Corn ground in a grist mill that is run by steam will generate so much heat within itself or acquire the heat in some way from the machinery that it will burn and spoil itself, if left in large bulk after being ground; but corn ground in a water mill or mill run by water power will not heat itself or be affected in this way.

These observations are enough to make me believe that there may be a great deal of difference in the healthfulness of different kinds of motive power. I would like to ask if it is a subject to which any attention has ever been given, and if you are aware of anything that has ever been written on the subject. I have already written to one or two prominent specialists on nervous diseases, but have not been able to find out that there is any literature on this subject in existence. If you can give me any information on the subject or any suggestions that will help me to pursue it further, I shall be very grateful. I would also like to know what the reason is that grinding by steam power heats corn, whereas grinding by water power does not.

If there are any of your numerous readers who have been interested in this subject of power I would be glad to hear from them. Albert W. Dennis.

Salem, Mass., July 20, 1904.

The Accident to Mr. Barton.

The maiden ascent of the Barton airship, which was to have taken place early in the morning of July 4 last, had to be abandoned, owing to an unfortunate accident which seriously injured the inventor. The gas bag was in course of inflation, the hydrogen for which was being generated in the usual manner by the decomposition of sulphuric acid with iron. The inventor was examining one of the gas retorts, when the cylinder suddenly exploded with terrific force. The inventor unfortunately received the full charge of the explosion in his face, his hair, eyebrows, and mustache being completely burned away. Furthermore, many steel splinters entered his eyes, completely blinding him. Dr. Barton was conveyed to his home on a stretcher, and it was found upon examination that his injuries, especially to his eyes, were of a very severe nature. It was at first feared that his eyesight was destroyed, but the steel splinters were successfully removed. Although he is now progressing favorably, some uncertainty exists as to whether his sight will be affected, and it will be some weeks before he can again superintend operations. The balloon fortunately was not injured by the concussion, and the work of inflation was continued. By the time the inventor is recovered, the airship will be in complete readiness for the first ascent.

THE BERGER DISINFECTING LAMP.

The object of the lamp that a Parisian inventor, named Berger, his introduced, is to produce a disinfection through the disengagement of formic aldehyde and ozone resulting from the combustion of rectified alcohol, wood spirit, or a special product called ozoalcohol and containing essential oils distilled from labiate or myrtaceous plants.

The lamp owes its wonderful properties to a mantle of secret composition. The lighting of it is accomplished very simply. A few drops of alcohol are sprinkled upon the mantle and ignited. When the mantle becomes incandescent the flame is blown out. The incandescence is then kept up by means of alcohol supplied by the wick.

The inventor recommends his apparatus for disinfecting and deodorizing apartments, and especially sick rooms. If the lamp disengages formic aldehyde and ozone, there could be nothing better; but does it not disengage also carbonic oxide, or at least carbonic acid? It seems difficult to burn a hydrocarbide without obtaining one at least of these gases, which are far from being hygienic.

During the recent maneuvers between the submarine flotilla and the battleship squadrons of the British navy, some ingenious ruses were adopted by the former to mislead the latter, with conspicuous success. One of the most successful was the building of an exact replica of the conning tower and a short length of the top of the submarine, of canvas material. This was painted the same color as the submarine, and was attached to the top of the craft. The submarine then traveled toward one of the hostile vessels, and when within range and as conspicuously as possible, the canvas structure was released. It immediately floated to the surface of the water. Directly the submarine had discarded the mock structure it sank again, and completely altering its course approached the vessel from another quarter. The canvas ruse being conspicuous immediately attracted the warship's attention, and a severe fire was directed upon it. While this firing was in progress the submarine arose again to the surface on the opposite side of the warship, and succeeded in launching a torpedo unobserved and at close range. The ruse was therefore completely successful. The possibility of catching submarine boats in steel nets was again shown, as recently described in the Scientific American. The nets were of an improved type, larger and considerably stronger than those previously employed. The experiment, however, proved again successful, as the submarine after being caught in the net was so completely entangled that all its efforts to escape were futile. Several other novel attempts with other trapping and deceiving devices were carried out, but owing to their important nature the results obtained were maintained a strict secret by the Admiralty.

Some interesting experiments to demonstrate the rotation of the earth are to be carried out with marbles in the Pantheon at Paris. The marbles will be dropped from the cupola to the ground, and careful records of their deflections during their descent made.

WHAT THE LOSS OF THE PORT ARTHUR FLEET WOULD MEAN TO RUSSIA.

In making a general statement of the relative strength of the navies of the world, it is necessary to define clearly the basis on which such estimate is made. Otherwise, the comparison is apt to be misleading. A few months ago the Bureau of Intelligence of the United States navy made some valuable comparisons, based upon its own invaluable sources of information, in one of which the navies were compared on the basis of the number and displacement of warships actually completed on January 1, 1904, and the other on the basis of the number and displacement both of the warships actually completed and of those under construction at that date. It should be noted that in these estimates no account is taken of gunboats and other vessels of less than 1,000 tons displacement, nor do they include transports, dispatch vessels, converted merchant vessels or yachts, or obsolete cruisers. Vessels, moreover, that are authorized, but upon which no actual work of construction has been done, are excluded from the comparison.

At the outset, attention should be drawn to the fact that although the United States has a most liberal programme of construction in hand, the great delay in completing our ships causes us to make a relatively poor showing in a comparison of vessels actually completed, the United States coming fifth on the list and below Russia and Germany. Furthermore, were the vessels which are now building for the various navies of the world completed, the United States would move up from fifth to third position, with Germany fourth and Russia fifth. About a month after the publication of these tables by the Bureau of Intelligence, the war between Russia and Japan opened with the loss of several vessels of the Russian navy, and such serious damage to others, that they must of necessity be deducted from the total available ships of the navy. This has been done by reckoning the battleship "Petropavlovsk," the cruisers "Variag" and "Boyarin," the torpedo transport "Yenesei," and the gunboat "Korietz" as hopelessly lost. If the battleships "Czarevitch," "Retvizan," and "Pobieda," and cruiser "Pallada," which, after having been repaired sufficiently to become once more an active fleet, were to be destroyed either by the Russians themselves, to avoid their falling into Japanese hands, or by the Japanese in a sea fight, the subtraction of this tonnage of about 70,000 from the Russian total would cause Russia to drop from third to fourth position, Germany taking her place in the relative standing of the navies as they now are. The same transposition has to be made in the table showing the comparative strength of the navies, were the ships that are now building completed, Germany coming fourth, or next to the United States, and Russia fifth.

It would be mere guesswork to endeavor to modify the second comparison by the losses which may occur to both the Russians and Japanese before the war is ended. If the Baltic fleet should be sent out, and succeed in raising the siege of Port Arthur, there might be a great naval engagement, attended with such a serious loss of Japanese ships, as would throw back the development of this, the youngest among the navies, for a full decade. On the other hand, if, as now begins to look possible, the Baltic fleet be not sent out, it is likely that Port Arthur and Vladivostock will be captured, and the whole Asiatic fleet of Russia destroyed or taken. If this should occur, it would involve the loss of the cream of the Russian navy, since for the past few years, the new Russian ships, as they have been completed, have been dispatched to the Far East. The total loss would include seven battleships, four armored cruisers, seven protected cruisers, and a few gunboats, making a total of about 170,000 tons. In this case the Russian total, if all ships now under construction were completed, would be about 388,875 tons. She would still rank fifth in point of displacement, or about 60,000 tons larger than Italy, but a long way below the next nation, Germany. This, however, is mere speculation; and we have only changed the figures of the tables of the Bureau of Intelligence so far as they are actually affected by the war, to the extent of including in the totals for Japan the two cruisers purchased from Chile, and by subtracting from the Russian totals the vessels known to be lost or seriously disabled.

RELATIVE STRENGTH IN WARSHIPS, JANUARY 1, 1904.

To-day.		If all ships now building were completed.	
	Tons.		Tons.
1. Great Britain...	1,516,040	1. Great Britain...	1,867,250
2. France.....	576,108	2. France.....	755,757
3. Germany.....	387,874	3. United States...	616,275
4. Russia.....	346,458	4. Germany.....	505,619
5. United States...	294,405	5. Russia.....	488,732
6. Italy.....	258,838	6. Italy.....	329,259
7. Japan	243,586	7. Japan	253,681

The engravings on the front page of this issue represent the comparative strength of the navies of the world, were all the ships now under construction completed. Each navy is represented by a typical battleship of that navy, the size of the battleships corresponding to the relative strength of the navies. In each case the basis of comparison is a battleship representing by its size the total tonnage of vessels built and building for Great Britain, namely, 1,867,250 tons. In the upper engraving the vessels are imposed one above the other in order of their size, and in the lower engraving they are shown bow on. The next largest total to that of Great Britain is that of France, 755,757 tons; then comes the United States with 616,275 tons; Germany, with 505,619 tons; Russia, 488,732 tons; Italy, 329,257 tons; and Japan, with 253,681 tons.

Of course, it must be understood that these figures are a guide to the future standing of the navies of the world, say in four or five years from the present time, only if we suppose that the relative rate of building and the relative liberality of appropriations for new construction remain the same. Thus, if our own contractors are as slow in completing ships as they have been in the past, where construction has lagged from one to three years behind contract dates, we might find ourselves in the fourth instead of the third position; and, therefore, the value of the flattering estimate of our future naval standing, shown by these tables, will be dependent very largely upon considerable increase in the punctuality with which contracts for naval ships are completed.

An Interesting Utilization of the Cooper Hewitt Light.

A series of remarkable moving pictures has been recently secured at the plant of a prominent Pittsburg machine company by the American Mutoscope and Biograph Company with the aid of the Cooper Hewitt light. These pictures were taken for exhibition in St. Louis in the private auditorium of the company on the Fair grounds. When "moving pictures" of the Jeffries-Sharkey heavyweight contest at Coney Island were taken the scene was an arena interior. The ring was cut down to 20 feet, and 400 arc lamps were strung above it, the heat from which caused the combatants much discomfort. In several of the pictures in question the entire length of a quarter-mile aisle is shown, and at no time were more than sixty-four of the mercury vapor tubes used. The camera was placed on a platform fifteen feet from the ground, suspended from an electric traveling crane. The crane was moved slowly down the long aisle about 50 feet in the rear of the Cooper Hewitt lamps, the latter being also suspended from a traveling crane moving at equal speed. So far as possible in the taking of these pictures, any sunlight through the glass skylights of shops was taken advantage of, but it is not safe to depend very much upon the help of the sun in a moving picture which is four or five minutes in the taking. The sixty-four lamp tubes were hung in sets of eight, in eight frames. They required only 30 to 40 kilowatts, or about one-fifth of the energy consumed by the four hundred arc lamps referred to above. The camera made fifteen exposures a second, or nine hundred to the minute. Among the more interesting pictures are the welding of a ten-foot ring for an electric generator, the railway motor aisle, the forging of a ten-ton steel crank-shaft by a thirty-ton steam hammer, one of the eight main quarter-mile aisles devoted to the construction of big power types and a six-minute view of employes leaving one of the shops in East Pittsburg.

Death of Dr. Isaac Roberts.

Dr. Isaac Roberts, well known as a geologist and astronomer, died at Crowborough, England, July 18.

The original investigations of Dr. Roberts in the domain of astronomy have added largely to man's knowledge of the stars, clusters, nebulæ, and the structure of the universe.

The honorary degree of doctor of sciences was conferred upon him by the University of Dublin in 1892. In 1895 he was awarded the gold medal of the Royal Astronomical Society, on the council of which he had served for several years. He bore the titles of Fellow of the Royal Society, Fellow of the Royal Astronomical Society, and Fellow of the Geological Society.

Since 1890 his investigations had been continued at his observatory at Starfield. Two quarto volumes of his "Photographs of Stars," "Star Clusters," and "Nebulæ," with scientific deductions founded upon them, were published in 1893 and 1900.

Experiments have begun at the United States proving ground, Indian Head, with several kinds of smokeless powder. The preference thus far seems to be for the macaroni-shaped powder, which comes in strips, rather than for the flat powder. An endeavor will be made to find a satisfactory ammunition bag, possibly of smokeless powder cloth and twice as long as the present bag. If smokeless powder can be made with success in 40-inch strips the larger-sized bag will be adopted for use in the navy. The advantage of this will be that only two bags, instead of four, will have to be inserted in the gun, and thus the rapidity of fire can be increased.

Electrical Notes.

The Neu-Catrice lamp was introduced to the notice of the mining fraternity at a recent meeting of the Institution of Mining Engineers. It has small accumulators, two cells in all, and the electrolyte is contained in such a way that the lamp can be held in any position without spilling the fluid. Small charging plugs are provided, and the lamp can only be lighted when a small shutter—connected with the switch—is closed and the charging plug withdrawn. In one size the whole apparatus weighs rather less than 4 pounds, and gives 0.8 candle power for 11 hours; a larger size weighs 5 pounds, and gives 1 candle power for 15 hours. A special charging table is used, on which the lamps—connected in series—are charged daily by the colliery dynamo. The cost of maintenance has been found, at the Bruay collieries, to amount to one halfpenny per lamp per diem. The total working cost of electric mining lamps has been found to be seventy-five cents per lamp per annum more than that of the ordinary oil lamp; but this does not seem to be a high price to pay as an insurance against explosion in mines, more especially in cases where the atmosphere is dangerous.—Electrical Magazine.

A new kind of microphone was recently described by the inventor, M. Tariel, before the French Physical Society. The novel feature of the instrument is the special way of preparing the carbon grains and other similar bodies. After taking carbon plates only 0.15 to 0.2 millimeter in thickness, having a perfectly plane and polished surface, and breaking them by hand into small pieces, the fragments are passed through a sieve, the meshes of which can be traversed only by particles of less than 1 millimeter. This powder is introduced into a microphone, arranged as follows: A movable electrode, constituted by a carbon plate of the same thickness as the particles, is connected with one of the terminals of the telephone line, while the other electrode is formed of a carbon block in the neighborhood of which the particles are placed; this electrode is arranged on a thin carbon plate, to which the other wire of the line is connected. The distance separating the electrode is just 1-10 millimeter, the whole being solidly fixed in a ebonite box. The following merits are claimed for this new device: On account of the great number of contacts between the plane and light particles used, the apparatus is highly sensitive. The vibrating surface is diminished as compared with other types of microphone, and there are no insulating bodies retarding the vibrations between the two electrodes, such as felt, wool, etc. There are further no polarization phenomena, and the apparatus will not give rise to the production of electric arcs. It will finally be possible to construct microphones of smaller weight, smaller dimensions, and at the same time of a sensitiveness at least identical with that of other types of apparatus. When connecting with this microphone a small receiver, the terminal of which is introduced into the hearing circuit, a complete microtelephonic apparatus of the minimal weight of 27 grammes is obtained, which can be held to the ear by means of a spring.

The Current Supplement.

The current SUPPLEMENT, No. 1491, opens with a copiously illustrated article on modern coal-hoisting apparatus. Prof. H. L. Callendar describes some instructive experiments on an air-cooled petrol motor. Scientific experiments on this type of engine have been comparatively few, for which reason Prof. Callendar's work is all the more valuable. Mr. Richard K. Meade exposes the fallacy of the tests ordinarily applied to Portland cement. In an interesting article entitled "'Striking Objects Found at Carthage," the Paris correspondent of the SCIENTIFIC AMERICAN describes some noteworthy archeological discoveries. The N-rays are again made the subject of some discussion. It will be remembered that Dr. H. W. Wiley, of the United States Department of Agriculture, some time ago began a series of elaborate experiments, for the purpose of determining the effect of well-known preservatives upon food, among them borax. The experiments have now been concluded. A digest of Dr. Wiley's report is published in the current SUPPLEMENT, and will doubtless be read with considerable interest. Mr. Emile Guarini begins a series of articles on the electro-metallurgy of steel, which may well be considered a most exhaustive review of the entire subject. Although the present installment is unillustrated, the articles that will follow will be exceptionally well illustrated with diagrams and photographs. The Paris correspondent of the SCIENTIFIC AMERICAN continues his technical description of the racing cars in the Gordon Bennett Cup Race, describing in this installment the Mors car, the Belgian Pipe car, and Mr. Edge's Napier car.

ELECTROSTATIC ILLUMINATIONS: INTERESTING EXPERIMENTS FOR THE INDUCTION MACHINE.

BY HOWARD B. DAILEY.

Among the multitude of attractive experimental possibilities suggested by high-tension electricity, there is no class of phenomena susceptible of more interesting treatment, or in whose development lies fairer promise of gratifying result from simple apparatus, than the beautiful luminous effects of the static discharge over interrupted conductors. A certain few pleasing experiments of this character have long formed a familiar subject of illustration in most of the older works on physics; however, very little recent effort toward any amplification of these beautiful effects has been made.

Ordinarily, in such experiments the conductor remains at rest, its cut spaces illumined by the electric discharge, the value of the result as a spectacle depending upon the necessarily limited disposition that can be made of the luminous conductor; but by arranging the latter to be kept in rapid motion, so as to call into play the phenomenon of persistence of vision, this form of experiment becomes at once susceptive of some exceedingly fine adaptations.

To those having at hand a good static machine the illumination of such objects as wine glasses, vases, lamp chimneys or any symmetrical glass object of this sort becomes easy, and constitutes one of the most beautiful of all the varied line of possible visual effects. Fig. 1 suggests the method of arranging such articles for illumination. In the example illustrated a large goblet of thin glass is held by three small screws upon a revolving platform having upon its under side a small grooved pulley which is belted for moderately rapid rotation to a suitable hand wheel. A single narrow strip of tinfoil, 1-16 of an inch wide, is cemented over the glass with thick shellac varnish as follows: Starting under the goblet at the spindle of the whirling table, with which it makes contact, the strip proceeds to the edge of the foot of the glass, which it follows for perhaps an inch; thence in a curved line across the base to the stem, which it ascends in a straight path; then, over the bowl of the goblet in a somewhat sinuous course to the upper rim, after following which for about one-third its circumference it descends upon the inside, and terminates in the center at the bottom. All that portion of the tinfoil on the outside and along the upper rim is divided every eighth of an inch with a knife point, those parts within and under the goblet being left intact. The divisions should be carefully gone over and examined to see that they are all perfect and of sufficient width to insure a good bright spark at each break when the current from a Wimshurst machine is passed through the foil. Current is led into the strip through binding posts attached respectively to the supporting spindle of the whirling table, and to the foot of a vertical conducting standard formed of brass tubing, rising from the base of the apparatus at some distance from the goblet. The curved upper part of the standard, formed of thick wire, is made removable to allow of changing the object to be exhibited, one end fitting into the brass tube, the other terminating in a fine, straight, stiff wire that extends down inside of the goblet, nearly touching the end of the tinfoil strip. A piece of glass tubing covers the lower part of the standard for purposes of insulation. When the glass is whirled rapidly with the static discharge passing over it in a darkened room, the effect is one of exceeding beauty. Surrounding objects and even the substance of the goblet itself are invisible. Nothing is seen but the brilliantly luminous strip, multiplied many times by persistence of vision, and seeming to cover the whole glass at once, studding it most beautifully all over with innumerable jewels of sparkling light. Some idea of the general aspect of the experiment may be gained from the second illustration.

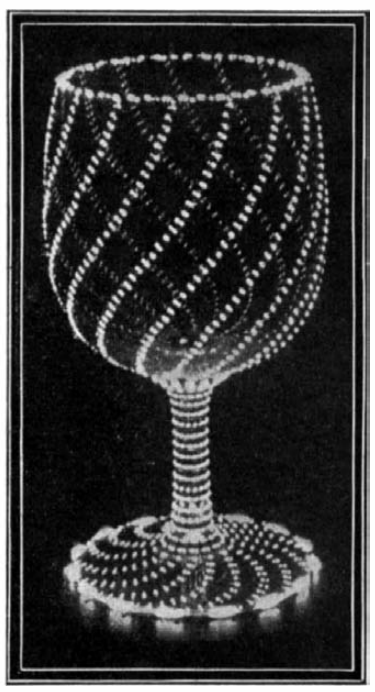


Fig. 2.—LUMINOUS GOBLET.

The ornamental irregularity seen around the periphery of the foot of the goblet is obtained by cutting out of that portion of the tinfoil following the edge a section about ⅜ of an inch long, producing at this point a spark longer and brighter than the others. The same might be done with the upper rim if desired. Should it be desirable to produce these results on a larger scale, such objects as fish globes, show domes, large bottles, etc., may be used, the style of decoration being capable of considerable variation through the disposal of the luminous strip.

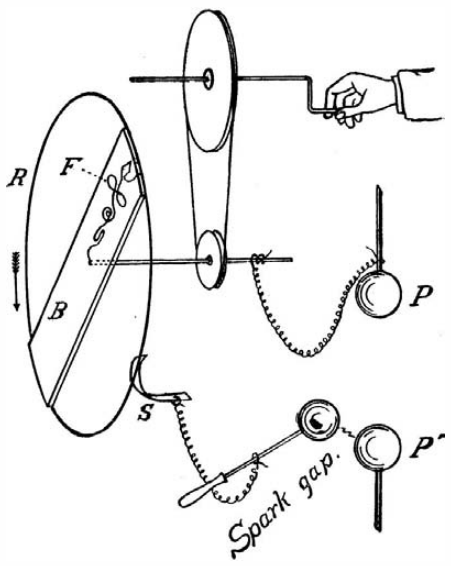


Fig. 3.—DIAGRAM SHOWING APPARATUS EMPLOYED.

One of the finest of luminous optical effects with which persistence of vision has to do is that known as "Gassiot's wheel," produced by the rotation of a single Geissler tube. Owing, however, to the fragility and expensiveness of Geissler tubes and the difficulty of mounting them safely for rotation, the spectacle is rarely exhibited. A beautiful modification of this experiment, utilizing the interrupted conductor, and having the advantage of simplicity and substantialness, will be understood from Fig. 3. A thin, smooth, well-shellaced board, *B*, 24 inches long, is mounted at its middle on a metallic shaft so as to be capable of rapid rotation edgewise. On the back of the board at each end are screwed two small plates of sheet brass to which is soldered, in such a manner as to be concentric with the shaft, a ring, *R*, of stiff wire, about equal in diameter to the length of the board. A narrow tinfoil conductor, *F*, divided at ¼-inch intervals, is laid on one half the board in some fanciful shape, insulating with thick, transparent mica wherever the foil crosses or returns upon itself. The ends of the strip make contact with the shaft and ring respectively. From the opposite poles, *P* and *P'*, of an influence machine wires are run, one direct to the shaft and the other through an adjustable spark gap to a stationary spring, *S*, of thin leaf copper, or a small tinsel brush, bearing lightly against *R*. When the board is whirled in the dark with the static discharge in action, there appears a magnificent, brilliant, many-armed star of generous size. The original of the photograph, Fig. 4, produced in this manner with a large generator, was over three feet across. Exquisite color effects may be secured by placing over different portions of the luminous conductor pieces of mica stained thickly with transparent water colors, such as are used for coloring lantern slides, photographs, etc. The speed of rotation for the above experiments should approximate 450 turns per minute to insure good persistence effects.

The spark fulfills an important function in all interrupted conductor experiments, especially those in which the conductor is to be rotated. Evidently, in the latter class, the spark discharge from the influence machine must occur at regular time intervals, or the elements of the luminous figure will not appear evenly spaced. The gap operates to effect the necessary steadiness of discharge, besides adding greatly to its brilliancy. It also increases materially the power of the generator to overcome a given resistance. Through its use, in conjunction with the two small Leyden jars of a medium-sized Wimshurst machine, the writer has been able to send with ease an apparently continuous discharge entirely around a room fifteen feet square over a tinfoil conductor divided every two inches, the same being shellaced directly on to the wall paper near the ceiling, the latter also carrying as a centerpiece a large circle, similarly made, over four feet in diameter. To an observer seeing it for the first time, this effect is novel and surprising. The whole atmosphere seems aglow with a subdued, mist-like radiance—pale, shimmering, and weird. The gap should be arranged between two large, rounded surfaces, such as smooth metal or foil-covered wooden balls, 2½ inches or more in diameter, one of them on a sliding rod for adjustment.

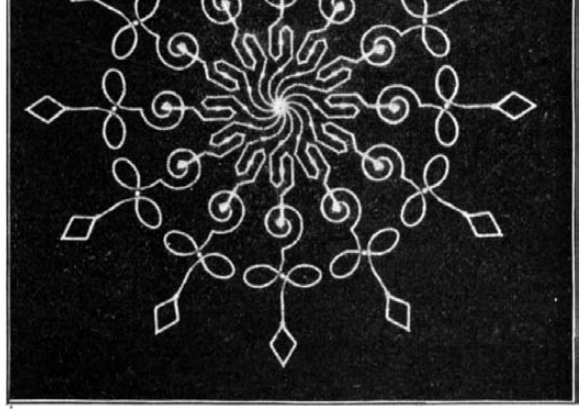


Fig. 4.—COLORED ELECTRIC STAR PRODUCED WITH INTERRUPTED CONDUCTOR.

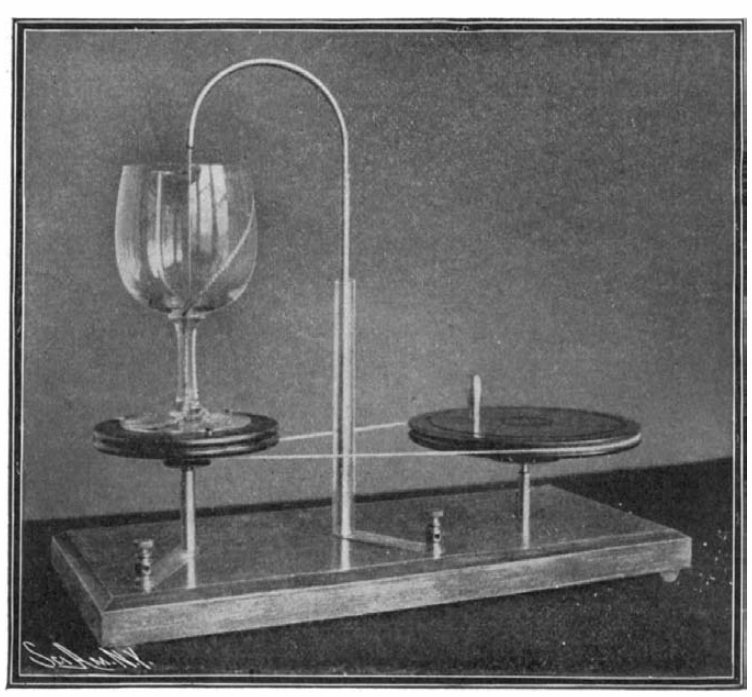


Fig. 1.—GOBLET MOUNTED FOR ILLUMINATION.

Acid-proof Rubber Goods.

Dr. C. O. Weber says, in the India Rubber Journal, that pure vulcanized rubber is very little acted upon by acids; the less pure the smaller the capability of the rubber to absorb aqueous liquids. It is well known that Para rubber on prolonged immersion in water will eventually be found to have absorbed from 24 to 28 per cent of water. On testing different brands of rubber in this respect, it is soon found that they exhibit great differences in their capability of absorbing water, and it is also found that this variation very closely follows the percentage of resinous matter contained in the various brands. This should not, however, be taken to amount to a recommendation to use, in the manufacture of acid-proof goods, resinous, low-class rubbers only. This would in so far be a mistake, as the rubber substance proper of the low-class rubbers is itself much more readily affected by the above-named acids than the high-class rubbers, notably Para. But this observation of the decreased capability of low-grade rubbers to absorb water clearly indicates the line to be followed in the production of acid-proof goods. It will, indeed, be found that mixings of Para with resins show a very much decreased capability of water absorption, but there are, as a matter of fact, several substances which prove far more efficient in this respect than the resins and which at the same time are less objectionable for compounding purposes than the latter. These substances are paraffin wax, ceresin, mixtures of paraffin wax and heavy mineral oils, and, better still, the products obtainable by treating paraffin wax with sulphur.

Cold Storage of Apples.

The conditions under which the prolonged storage of apples may be successfully carried out has been studied during the past two years by the United States Department of Agriculture, and the cold storage of apples has now made this fruit available practically the whole year round. Several hundred different varieties were stored in order to make the tests. It appears that there is no difficulty whatever in storing apples in the autumn and keeping them until late in the following spring. All that is apparently necessary is to keep an equable temperature; just about freezing point is the most satisfactory.

THE WORK OF A WESTERN CYCLONE.

BY DAY ALLEN WILLEY.

The wind storms which so frequently pass over various parts of the West in the form of cyclones or tornadoes have produced some curious results in damaging structures, but it is a question if any disaster of this kind has ever left more remarkable wrecks in its path than that from which the town of St. Charles, Minn., suffered. St. Charles is located in Winona County in the extreme southeastern portion of the State, about twenty miles from Rochester and near the Mississippi River. It is a typical northwestern community, having about 1,500 population. It is the market for a rather extensive farming region, and in addition to storehouses, includes a grain elevator, a flouring mill, a furniture factory, and several other industries. Nearly all of the stores were built of brick, as well as the schoolhouse, which was the most substantial structure in the town.

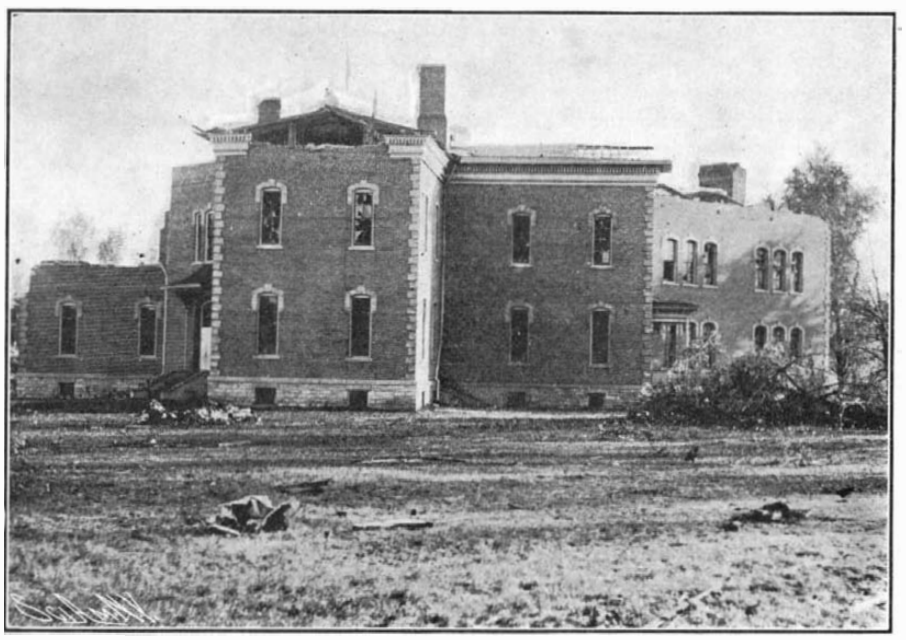
The day of the disaster was clear and sunny until about 10 o'clock in the forenoon, when light clouds began to obscure the sun. The mercury indicated a rapidly-rising temperature, while it was noticed that the barometer was falling with equal rapidity. The atmosphere became so "thick," to use the expression of an eye-witness, that the sun was completely obscured by noon, and the town was enshrouded in darkness as dense as if it were midnight.

It was calculated that the cyclone which developed did not last over one minute, being followed by vivid flashes of lightning which accompanied a hail storm, then a heavy rain. The entire disturbance, however, did not last over five minutes, when the clouds dispersed appeared, the rest of the day being as bright and clear as before the disaster.

So wide was the track of the cyclone, that every building in the community but three suffered more or less from its violence, although there are about two hundred structures in the town. While several of the smaller dwellings were leveled to the ground, many of the other buildings were left standing in various conditions, although the walls of most of them were so weakened as to require rebuilding. The public schoolhouse, as will be seen by the illustration, comprised a main building with two side wings, a small addition in front and a diagonal addition in the rear. The brick walls were reinforced with heavy stone at the corners, while the roof was of metal. Every pane of glass in the main portion was demolished with the exception of two. A portion of the roof was completely lifted off, one sheet of metal being blown against a small tree with such force as literally to cut the trunk in two. Fortunately the school children were at their homes at lunch, and no one was injured in the building. One of the upper floors of the school was actually blown out of the rear portion, and the furniture with it, but the rooms on the lower floor were but little injured.

On the main street Mr. George Jesson, a dentist, had an office in the second story of a frame building. It is stated that he was working with a patient when the cyclone struck the town. As the illustration shows, the front wall of the upper portion of the building was ripped off. The wind current actually forced the two men through the side of the building, killing the dentist and severely injuring the patient. The

Building Containing the Dentist's Office. The Room on the Right was Occupied by the Dentist. He was Thrown Through the Wall at the Left and Killed.

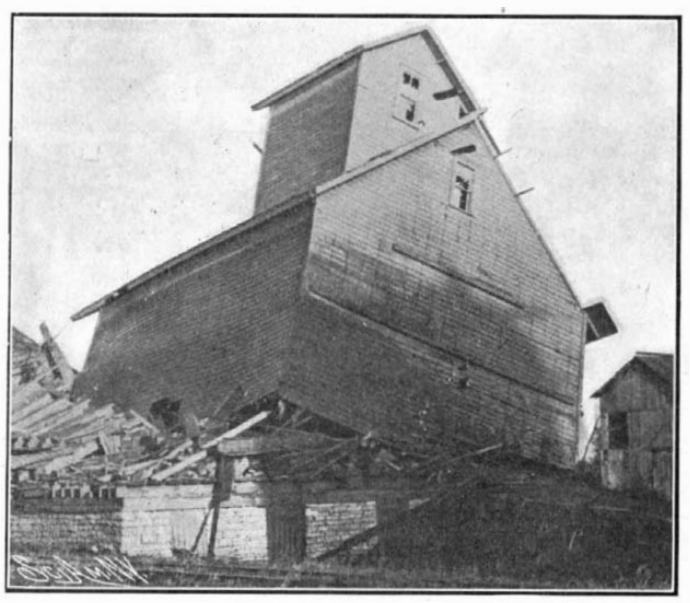


The Wrecked Schoolhouse, Showing the Damage Done to the Upper Portion.

Wreck of the Furniture Factory.

An Upturned Dwelling.

Scene at the Railway Station, Showing the Ruins of the Depot and What is Left of the Grain Elevator.



The Flouring Mill Lifted Off Its Foundation.

hole through which they were thrown is shown at the left of the picture. Near by stood a furniture warehouse, having front and side walls of brick, while the floors were supported by heavy wooden beams. The warehouse was practically demolished, and most of its contents, including beds, mattresses, bureaus, and other furniture, ruined. In one of the apartments was stored five hundred chairs. Apparently the force of the storm was spent in this portion of the warehouse, for every chair was actually blown out of it, some of them being found several hundred feet away. Nearly all of the chairs were more or less broken.

The elevator was located near the track of the railroad, adjacent to the depot. It was substantially built, having a framework of dovetailed timbers covered on the outside with heavy planking. It was nearly filled with grain awaiting shipment, and at the time of the disaster, several cars were being loaded. In spite of its heavy contents, which acted as so much ballast, the sides of the elevator formed such resistance to the force of the wind that it was moved about twenty feet from its foundation and the top blown off. The downward suction of the air current apparently produced a centrifugal motion inside, which removed most of the grain, some of it being found afterward a mile away. A train of about twenty box and flat cars stood on a siding near the station. One of the box cars, which was loaded with flour, was lifted from the rails, crushed like an eggshell, and the flour spread over an area of several hundred feet, the ground appearing as if covered with snow. Near the carload of flour was coupled a flat car loaded with lumber, every piece of which was blown off. The depot was reduced to a mere mass of wreckage, which can be seen in the illustration in front of the elevator.

Next to the schoolhouse, the flour-mill referred to was the largest structure in the town. It was built of wood, with gable roof surmounted by a cupola, and formed a target for the missiles of various kinds blown through the air. Pieces of wood varying from planks a foot in width and an inch in thickness to mere splinters, stuck in the sides and roof. Strange to say, the mill itself was but little damaged, although it is almost a total loss, for the reason that it was lifted up and carried nearly fifty feet from its foundation, and could not be replaced. In a number of instances two-story dwellings were lifted and thrown on their sides, and in one case a house was literally forced to turn a half somersault, as an athlete would say, being found lying on the roof timbers, the roof itself having been crushed in.

Considering the damage done by the storm, the loss of life was remarkably small. Nine persons were killed, while four were fatally injured, but a number of people escaped death and injury almost miraculously. Mrs. L. Sheridan resided on the second floor of a building on the main street. The lower part was used as a store. She was sitting in the front room when the cyclone came up. The front wall was torn away from the building from foundation to roof, leaving the roof and floors without any support on the side damaged. Mrs. Sheridan had the presence of mind to rush down stairs and out of the building just in time to escape being caught in its ruins, for the rest of the structure fell a moment afterward. A Mrs. Drew and two children were in their home—a frame dwelling two and a half stories high. The house was carried a distance of seventy-five feet, as verified by measurements made after the disaster, but none of the inmates was injured, although they were thrown to the floor of the room in which they were sitting. The roof of the house was torn off and lodged in a grove several hundred feet distant. The direction of the cyclone was such that a remarkably large number of stores and residences were damaged by the front walls being torn off, most of them collapsing as a result of the injury. One of the larger dwellings, owned by Christopher Lorensen, was left unharmed by the cyclone itself. About five hundred feet from it, however, stood a small shed built of heavy planks surrounding a well. This was thrown against the side of the Lorensen house with such force that it passed through the outer wall of boards and the lath and plaster which lined the interior, not stopping until it had struck the opposite wall, and partly breaking through it.

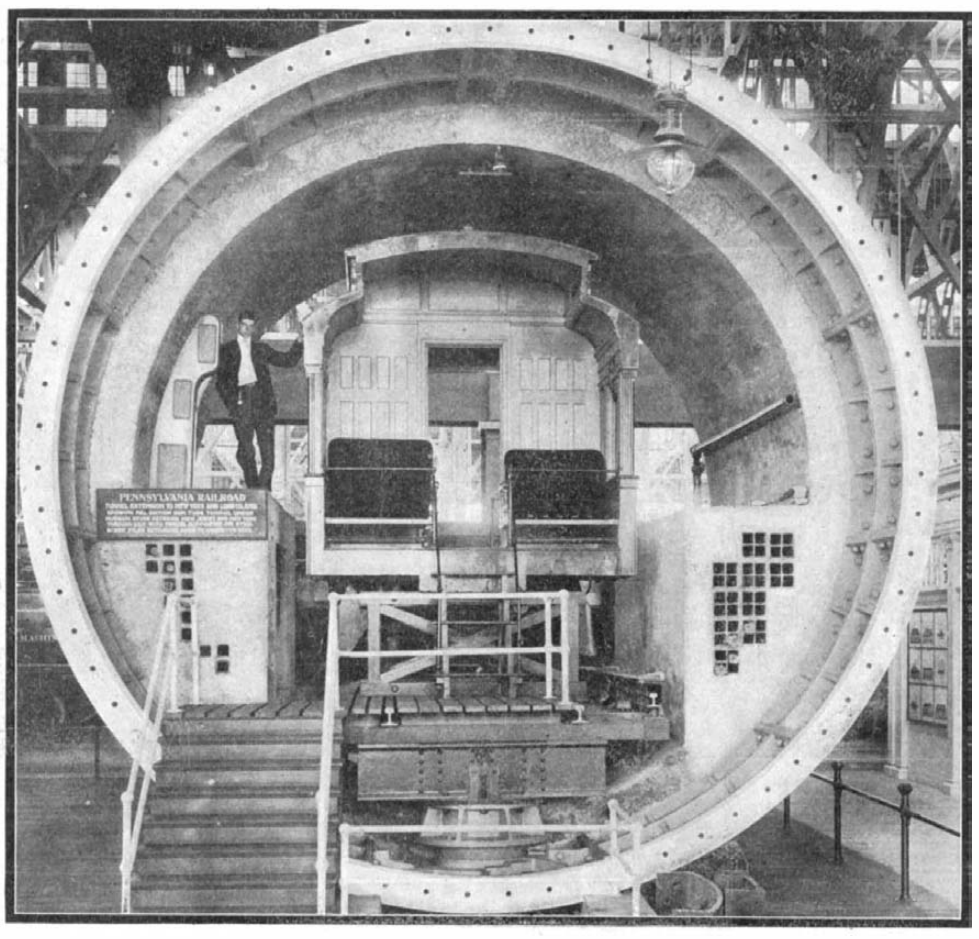
This was one of the numerous freaks of the cyclone. In another instance a case containing about twenty bottles of mineral water was blown out of a saloon into the basement of a building across the street, and when picked up but two bottles were found broken. When the work of rescuing the victims began, the people who hurried to the ruins were attracted to one spot by the howling of a dog, which they found alive although buried under a pile of brick and timbers, the timbers lying in such a way as to keep the weight from the animal. It was clasped tightly in the arms of its owner, who had evidently met instant death, being crushed by the timber which had saved the dog's life.

Probably the enormous force of the air current was more strikingly displayed by its effect on the opera house than even in the wreckage of the town. This was also built of wood, the sides being inclosed with thin clapboards nailed upon scantling. Although it was directly in the path of the cyclone, the principal damage done to the building was by pieces of wood in various forms, which were hurled through the air. A score of such missiles as strips of planking two inches in thickness, boards, and limbs of trees were found sticking out the side exposed to the storm, like arrows driven into a target.

A SECTION OF THE HUDSON RIVER TUNNEL AT THE WORLD'S FAIR.

BY THE ST. LOUIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The exhibit of the Pennsylvania Railroad Company at St. Louis includes an actual section of the Pennsylvania Tunnel that is being built beneath the Hudson River. When the Fair is over, this section will be taken down, and ultimately it will be built into place in the river mud. The section is made up of eight complete rings, each 2 feet, 6 inches long, making a total length of 20 feet. Through the bottom of the shell project two of the cylindrical cast-iron piles, and upon them is supported a section of the track floor-beams and stringers, with the ties and rails and third rail in position. The piles are to pass through the floor with a sliding fit. They will be carried, everywhere, down to rock, and consequently the load of the moving trains will be carried directly by the stringers as a bridge and by the piles as bridge piers, none of the shock or vibrations of the trains coming upon the tunnel tube, which will act merely as a protecting envelope for the trains.



A Section of the Pennsylvania Hudson River Tunnel at the World's Fair, With Section of Day Coach Inside.

The interior of the shell is lined with concrete, and a mass of the same material is formed at the sides of the tunnel up to the level of the car windows, thus providing two footpaths, along which passengers may walk in case of a breakdown of the train. The man in the photograph shows that there is ample room for this promenade.

Within the concrete mass are embedded the electric conduits. One of the block signals is shown adjacent to the man above referred to.

The interior of the tunnel is filled by a full-sized section of a first-class day coach of the Pennsylvania standard size, and in fact the whole exhibit is complete in every respect to the smallest detail.

In passing below the North River, it will be necessary, in order to avoid going to a depth which would involve heavy grades that would be expensive to operate, to carry the tunnel through a river mud and silt that are of such consistency that the question of the stability and perfect alignment of the tunnel calls for special study. Although the silt is sufficiently firm to preserve the tunnel itself in perfect alignment, it was considered by Mr. Jacobs that provision should be made for carrying the moving train loads independently of the tunnel shell. It was considered that if the heavy Pullman trains, weighing with their locomotives as much as 600 to 700 tons, were allowed to bear directly upon the shell of the tunnel, their weight and impact might produce a settlement and set up bending stresses that would result in fracture and leakage. The problem will be solved by driving a line of very massive cast-iron screw piles through the floor of the tubes, at 15-foot intervals, with their heads projecting within the tubes, and capping the piles with a system of heavy transverse girders and longitudinal stringers, upon which the track rails will be laid. The heavy load and severe impacts of the trains will thus be received by the piles, and should there be any slight settlement of the piles under load, the movement would not affect the tubes, which would serve their proper purpose as an envelope for the protection of the trains. The piles will be driven either to rock or to a bearing capable of sustaining a predetermined load. Of the 24,049 feet of cast-iron single-track tunnel, 12,174 feet will be reinforced with screw piles.

Does Body Make Brain?

In a recent number of the Contemporary Review appears a forcible and suggestive paper on "Play as an Education," by Woods Hutchinson. His chief contention is that the progress of investigation in the field of psychophysics continues more and more decidedly to indicate that the organization of the brain is bound up so closely with muscular activities that no educational scheme can be rightly based on a plan which does not take full cognizance of this fact. In the hydra the nervous organization consists simply of fibers which assist in securing food; there is no brain. In the starfish, the brain, if brain it can be called, is only a double ring of nerves about the mouth. As we ascend the scale of animal life we find similar rings about the nose and eye. The locus of these rings determines the capital of the body-state, and all the rest of the territory included in the area of the animal hastens to get a representation there. Such is the genesis of the brain. If these observations be sound, it may be inferred that the more complex and delicate the muscular life, the more complex and delicate will be the structure of the brain and the greater its intellectual power. This conclusion is supported by a study of the play of animals. The simplest organisms have no period of play. The frog has no play time. Birds have little. In this respect dogs and cats are their superiors in a degree commensurate with their superior intelligence. While the child plays he is organizing his brain; it is growing; he is gaining the power which in after years will enable him successfully to cope with situations demanding a well-trained mind. The lesson which lurks in this conclusion for teachers and school authorities may be condensed into a phrase: Shorter hours of study, and public school playgrounds everywhere. The latter should be under school supervision and should be recognized as an integral factor in education, not merely tolerated as a necessary evil or regarded as a side-issue. Athletics should likewise be cordially recognized as an essential part and force in the curriculum.

Ancient Fluorspar Mine.

The Blue John mine, at Castleton, Derbyshire, is famous for its beautiful fluorspar. Antiquaries have established the fact that the occurrence of this spar was known to the Romans, who found it probably while working the hills for lead. Anything that did not contain lead, the Romans threw to one side as worthless; and thus it was that quite recently, in a tunnel communicating with a shaft made by the ancient adventurers, the proprietors of the mine found one of the biggest and finest specimens of the rare mineral ever seen—a mass that had been placed there by the Romans nearly 2,000 years ago. The largest vase ever made from fluorspar is in the Chatsworth sculpture gallery, but it is said the lump just found might be worked into one to rival even that of the Duke of Devonshire.—Eng. and Mining Journal.

A TRAPDOOR SPIDER.

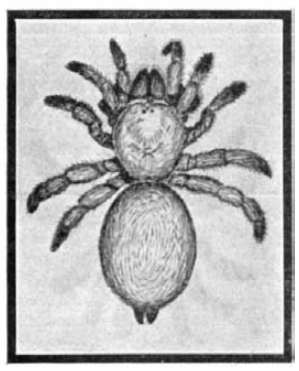
BY C. E. HUTCHINSON.

In many parts of California may be found in great numbers nests of the large trapdoor spider, *Bothriocyrtum californicum*.* The plow has been very destructive of these, but the writer once estimated that, in a certain locality long untilled, there were in a single acre as many nests of large size as there were square yards, while the very small ones, detected with difficulty, were far more numerous. Any but a close observer might walk over fields where these are common without observing a single abode, so perfectly does the door simulate the ground surface, especially when rains are frequent, as the door then becomes completely covered with growing vegetation like that about it.

Specimens of the nests—the upper part, including the door—are familiar objects in the shops of curio dealers, where they are offered for sale along with their stuffed and distorted builders.

Not of less interest than the nest is the life history of its maker. It lives much longer than spiders belonging to most other genera. One year after hatching it measures scarcely 3-16 of an inch in length, exclusive of limbs, while an adult measures 1¼ inches.

By measuring the yearly growth of immature spiders, of various sizes, that were kept under surveillance for that purpose for three years, it was found that ten or fifteen years are required for them to reach maturity. After that the spider's life is problematic; but several spiders known to have been adults three years ago are still relatively active. Bearing in mind its very peculiar life, which is one of little action, it is not unreasonable to believe that it may live more than twenty years, all told.

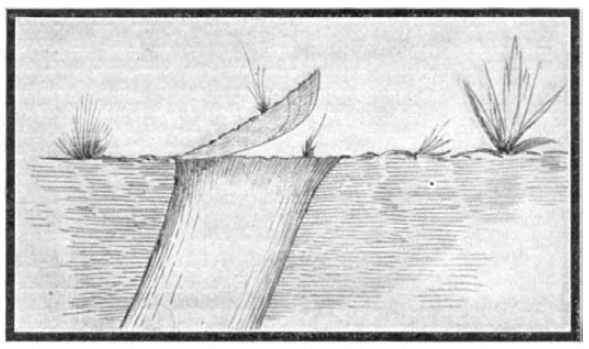


An Adult Spider.

More wonderful than its longevity is the fact that during its entire life, exclusive of the few months passed within the nest of the mother spider, it maintains but a single home, a tunnel in the ground, of its own digging, widening and deepening it as its own growth requires It will suffer from flood, famine, and devastation rather than abandon the home of its first choice. Without a knowledge of its habits, the significance of various layers of silk upon the underside of the door of its home is not apparent. The layers, which resemble thin white paper, are closely united, but may be separated with care. They are made one at a time, a single layer covering the entire underside of the door at the time the layer is fabricated. Once each year during the growth of the spider, the door, composed of earth and silk, is enlarged by adding wet earth to its free edge, after which a new layer of silk is applied, extending over the new as well as over the old part. As many as six or eight layers may be removed from an old door, but seldom more than that number, as the older ones disappear by process of decay.

When the door is removed, the spider makes a new one having a single covering. Other layers are subsequently added, even in the case of an adult, but in the latter instance the successive coverings lie wholly one upon another, not being separated at their edges by earth, as the full-grown spider has no occasion to reenlarge its door.

The operation of making the door is an interesting one, and the entire process may be observed without inconvenience by placing a spider in a box of wet earth. The hinge-bearing edge of the door is perfectly straight upon the upper side, as is also that part of the tunnel's edge to which it is joined. Against a central point on the straight edge of the tunnel's rim the spider first presses a small particle of mud. Being wet it adheres readily, which allows the artisan to turn about and spread over it a quantity of silk, which makes it more secure. On top of this, and at either end of it, other particles are carefully adjusted in like manner to the rim or to those in place, the operation being repeated until the structure is a third or a quarter of its destined width, when it is pulled over to a horizontal position, the spider presumably sensing



Longitudinal Section of Upper Part of Nest, the Dotted Lines on the Door Showing its Yearly Accessions.

an added security. Further additions to its edge are made by raising the door each time to a vertical position. The growing edge is circular in outline from the start, and is molded to the proper thickness between the fangs and mandibles of the builder.

No silk is purposely applied to the upper side, but the under surface is well smeared with it, the greater part being added a little at a time as each particle of earth is put in place. The word smeared is used because the silk of this spider and others of its class issues from long rows of pores in the underside of finger-shaped organs, which are drawn over a surface from side to side, and more often while in contact.

The employment of plastic earth in making the door makes the fitting of that object perfect; for while it is yet wet it is drawn down into the flaring opening of the tunnel, the soft edges yielding where pressure is greatest. When a door is well pulled down, water may stand over it for several hours without entering the tunnel further than to moisten the wall and its lining.

The heavy earthen door, usually of adobe, with its stout coating of silk, is well suited to protect the designer from insect foes, but in June or July the spider enters upon a period of inactivity which, in the case of those half grown or younger, extends through the summer and autumn or until the so-called rainy season appears; and these younger spiders, as an additional safeguard, barricade the door by packing wet earth against it from within, completely filling the upper part of the tunnel. The lower end of the plug is made dome-like, smooth, and is coated with silk like that covering the rest of the wall.

The adults do not employ a like means, but the immature spiders that are over half grown, and some adults, fasten the door with a quantity of silk applied to the wall of the tunnel and to the door at their line of contact, by which the door is well fastened down.

The protection afforded by these means enables the immature spider to pass through its helpless molting stage unmolested, and the adult female to fabricate her one egg cocoon of the year, and attend it, undisturbed.

The tunnel in which it passes this peculiar existence is, for the time, practically air-tight, being made usually in heavy clay, or adobe, very hard in summer, and having its smooth wall covered completely with a closely woven and firmly adhering coat of fine silk. Though much of the soil in which these spiders live cracks freely during the rainless summer, the cracks do not rupture the wall of the tunnel, which often appears harder than the surrounding soil, and may receive some special treatment in addition to the troweling, or smoothing, which the spider gives it.

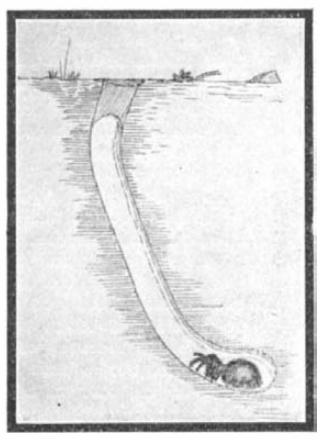
The spider's condition during this time of complete reclusion should not be described as lethargic, since it becomes active when disturbed, but it consumes no food whatever for five or six months, nor does it partake of water, unless such is gathered in some unexplained manner from the humid air of the closed cell.

Remarkable as are the natural conditions under which the spider exists throughout the dry season, it is capable of enduring like conditions for a much longer time, as shown by actual test in the case of three adults selected for the purpose. These were kept for sixteen months unquestionably without food, showing no ill effects from the treatment. In this instance proper food was offered at the end of twelve months—the writer not having the heart to continue the experiment longer—but the offering was declined, as the spiders were then enduring the semi-lethargic condition, out of which they emerged in due time, to take food naturally.

* For the name of this spider, I am indebted to Nathan Banks, Washington, D. C.

SOME NEW ADDITIONS TO THE UNITED STATES ZOOLOGICAL PARK.

Dr. F. W. Goding, United States consul at Newcastle, New South Wales, has secured for the United States Zoological Park the most important collections yet received from any one source, amounting to 140 specimens, among which are a Tasmanian zebra wolf with three young, a Tasmanian devil, three echidnas, thirteen kangaroos of various species, three phalangers, two flying phalangers, four native cats (*Dasyurus*), a black-backed jackal, a pair of emus, thirty cockatoos and paroquets, a wedge-tailed eagle, a pair of black swans, and many other birds.

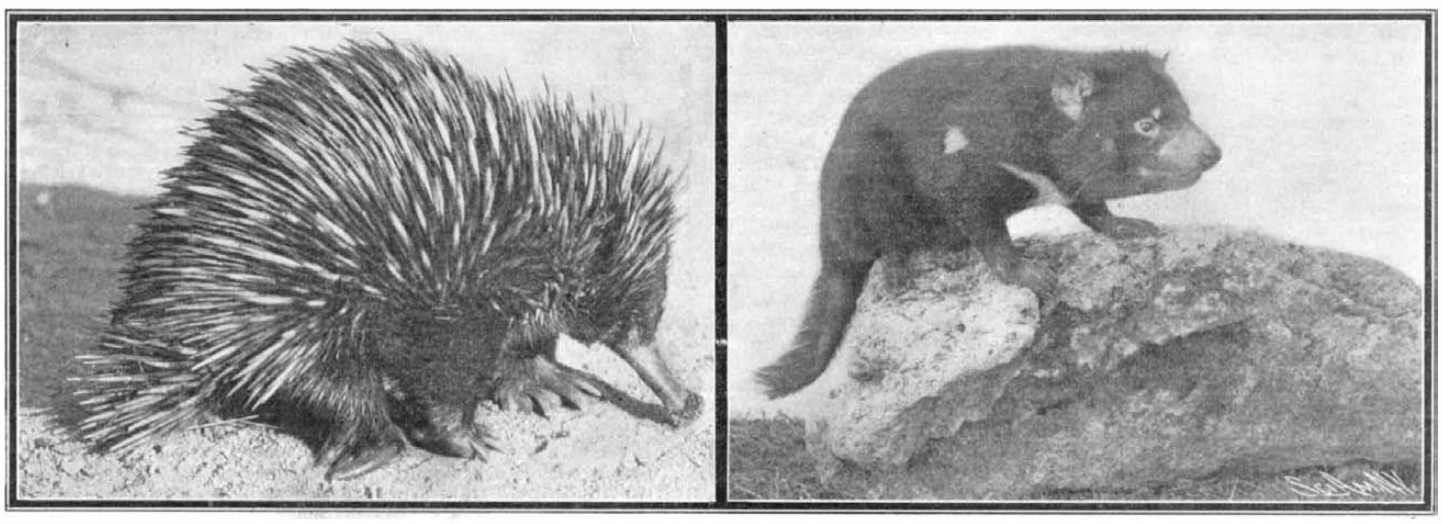


Nest of Young Spider, Showing Closed Door, Plug of Mud and Characteristic Trend of Tunnel.

The echidna, of which a specimen was sent by Dr. Goding, varies in length from 12 to 18 inches. Its broad, depressed body is mounted on very short, strong legs, terminating in big, powerful claws, suited to digging in hard ground. The small head terminates in a nose, which is prolonged into a slender snout. Although the mouth is toothless, the palate is studded with recurved spines. The slender, extensile glutinous tongue is well adapted for the capture of ants and other insects. Stiff, hedgehog-like spines mixed with long, coarse hairs cover the back of the animal. Much like a hedgehog is the animal's habit of protecting the under parts, which are spineless and clothed in silky brown hair, by curling itself up. The animal dwells in burrows of its own digging, and obtains its food by excavating in the hillocks of ants, which it tears open in order to devour the succulent larvæ. The echidna is gentle in disposition, endures confinement well, eats bread and milk, chopped eggs, and the like, and is frequently kept as an intelligent and playful pet.

The Tasmanian devil is a ferocious burrowing, carnivorous, dasyuroid marsupial (*Sarcophilus ursinus*) of thick, massive form with a large head and short, broad muzzle.

Our photographs were furnished by the Smithsonian Institution.



Echidna. Tasmanian Devil.

NEW ANIMALS IN THE UNITED STATES ZOOLOGICAL PARK.

The windmills seen in South Africa are almost invariably of American origin. It is said to be an exceedingly rare thing to see one of these from England or Canada, and the reason advanced is that the Britishers are unable to meet the prices asked by the American concerns, which are about half those asked for all others. Attempts have been made to influence the farmers there with the statement that the English machine is much more durably constructed, but it has been found by them that the American windmill answers all demands and lasts just as long as that constructed in England.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

MAGNETIC BRAKE.—J. F. Motz, Phœnixville, Pa. In this patent the invention relates to magnetic brakes, and more especially to the type of magnet used therein. The more particular object is to provide a brake in which the magnet will hold the armature when the mechanism is subjected to light loads, and especially when a series-wound magnet is used.

Of Interest to Farmers.

CRATE.—J. S. Horton, Lincoln, Del. In fruit transportation, particularly of peaches, freight-cars are fitted up with rows of shelves to contain baskets of fruit, so as to prevent the fruit from being bruised by pressure of one package against another. This practice is expensive to road and shipper, and the inventor's principal object is to provide a crate in which fruit may be packed and shipped without the above-referred-to expense. The crate is of sufficient strength to enable piling of one on the other so as to allow unrestrained circulation of air between them.

Of General Interest.

COATING EYELETS.—I. W. Giles, New Bedford, Mass. Eyelets, especially such as are applied to shoes and garments, are coated with japan or other varnish or paint. In applying the coat, which is commonly done by means of rotating rolls, the funnel-shaped throats of eyelets are apt to become filled more or less, and thus obstructed by an accumulation of coating material therein. Mr. Giles finds that this may be removed from eyelets and more evenly distributed on the enlarged ends or heads of the same by means of an air blast or current directed through the eyelets.

INDEX.—R. Bogue, Moose Jaw, Canada. Mr. Bogue's object is to provide a means by which a bookkeeper of commercial accounts is able to systematically arrange names so that time can be saved in finding both in index and index-books. Another, is to employ the marginal index in connection with a compact form of key-index and ruled account sheets or pages numbered in consecutive order and interspersed with groups of index-sheets, the whole adapted to be bound in a way to provide for the removal of a filled sheet or completed account, so that another sheet may be placed in the book as a substitute for the completed sheet.

TEMPORARY BINDER.—A. T. Baxter, New York, N. Y. The invention relates to improvements in devices for holding loose leaves or sheets in a secure manner, the same commonly known as "temporary" binders. The object is to provide an improved form of post capable of extension or prolongation on the gradual accumulation of the leaves, the post having its members interlocked and held in secure positive manner and always presenting the ratchet-teeth on its several members in position for engagement with bolts or dogs on the locking-slat.

SUPPORT FOR REFRIGERATING-CHAMBERS.—V. A. De Canio, Union Hill, N. J. The invention has for its object the provision of a movable support for use in ice-boxes and other refrigerating-chambers—such, for instance, as are used in hospitals, morgues, and the like—and arranged to permit convenient removal of the supporting-tray from the chamber or replacing it therein.

DUST-TRAP AND VENTILATOR.—F. E. Davis, Atchison, Kan. The inventor's object is to provide a dust-arresting trap for hot or cold air distributing pipes which will effectively coact with any heating or cooling apparatus wherein conduits for heated or cold air, or both, are employed for conveying warm or cool air to and from rooms and prevent intrusion of dust with the inducted air, a further object being to provide the dust-arresting apparatus with a foul-air conduit to remove vitiated air from rooms or inclosed spaces. It is adapted for use with the tubular conduits of hot-air distributing apparatus, and while the trap may be placed for arresting dust at each air-inlet to a room, it may be positioned at the junction of a cold-air pipe with the lower portion of a hot-air furnace.

WAIST-BELT.—T. Gallert, New York, N. Y. The purpose of the invention is to provide a buckleless belt which will fit snugly to the waist of the wearer, the said belt comprising a body-section, a front locking-section, and a cover-flap for the locking-section so constructed that it will lie flat in the fastened or closed position of the belt, remaining in cover position thereon, imparting to the belt the appearance of continuity.

PUMP.—W. J. En Earl, Montevista, Col. In this case the invention relates to improvements in pumps for general use, and particularly adapted for pumping water from mines or deep shafts, an object being to provide a pump of simple construction and so arranged that the packings are wholly protected from sand or grit and may be readily tightened when necessary without stopping the pump.

ICE-HOOK.—R. Hughes, Mount Vernon, N. Y. The intention in this improvement is to provide a hook for use in ice-harvesting, and other places, and arranged to permit convenient pushing and pulling of the ice blocks, to allow of readily changing and grinding the points in case one becomes dull, and to prevent the fastening devices for the points from being injured when the hook is thrown down.

Heating and Lighting.

HEATER.—A. G. Kaufman, New York, N. Y. The heater is arranged to produce complete combustion and a rapid circulation and heating of the air in the room to insure quick heating thereof or to allow of heating culinary and other vessels set on the heater, the consumption of gas by the heater being very economical and the flame confined within the heater, thus preventing accidental fires. The invention relates to heaters, radiators, and stoves for heating rooms, vessels, and the like and adapted to be attached to gas-burners.

HYDROCARBON-BURNER.—R. Matheson, San Diego, Cal. In its general arrangement this invention comprehends a novel construction of generating means, including a converter adapted to project into a stove or other casing in which the burner is held for the usual purpose, a jet-pipe forming an attached part of the converter, and a supplemental vaporizing means for initially heating the main converting or generating devices.

Household Devices.

FOLDING BEDSTEAD.—M. Benz, Nashville, Tenn. This invention is an improvement on a previous invention made by Mr. Benz for which he received a former Letters Patent; and the object of his present improvement is to simplify and increase the effectiveness and ease of operation of folding beds of the type represented by the aforesaid patent. A further object is to provide a bedstead which is both effective and reliable in use and one which may be readily manipulated with small exertion and carried into and out of position for use without noise or friction.

SHADE-ROLLER ATTACHMENT.—B. F. Bell, Nashville, Tenn. The improvement is in the nature of an attachment for shade-rollers, preferably those of the Hartshorn type—that is to say, rollers in which a hidden spring is wound up by unrolling the shade and is retained so wound up by a pawl or detent engaging the spindle on which the roller proper is mounted.

LOCK FOR EXTENSION-TABLES.—A. L. Crandall, Hanover, Pa. The object in view of this inventor is to provide novel details of construction, which enable the complete closure of the joint and the positive lock of the main sections of the table in closed position, affording convenient means for effecting such a locked closure and also for releasing the sections of the table when this is desired.

FILING-CABINET.—T. P. Dolan, Houtzdale, Pa. The purpose of Mr. Dolan's invention is to provide a cabinet for the convenient and systematic filing of letters, bills, invoices, and all kinds of documents and an accompanying index by means of which documents can be quickly and accurately located in filing, which index can be used for filing purposes if desired; but at such times a supplementary index is employed.

Machines and Mechanical Devices.

KNITTING-MACHINE.—S. A. Dodge, Millbury, Mass. The improvement relates to circular knitting machines; and its object is to provide an attachment arranged to automatically close all the needles for a number of courses to make a plain stitch and to then close alternate needles for a number of courses to form tuck-stitches, and thus produce a tubular fabric having transverse alternating bands of plain and tuck stitches which give the fabric an exceedingly fine and durable appearance and render the fabric incapable of shrinking unduly when made of pure wool or worsted.

BOTTLE-WASHING MACHINE.—T. Grebe, New York, N. Y. The invention relates to improvements in machines for soaking and washing bottles of that class wherein an endless conveyer is guided to travel through a succession of baths. In the service of ordinary machines bottles are sometimes broken, and washed bottles accumulate in the final tank too rapidly for removal. The first objection is overcome by the provision of a construction of a yieldable liquid-proof cushion in each bottle-holder of the conveyer, said cushion minimizing the shock and preventing breakage. Means are provided to permit rapid discharge of the washed bottles.

CASH-REGISTER.—E. H. Chapman, Port Chester, N. Y. In this patent, the invention relates to improvements in cash-registers of a type in which checks are deposited to visibly indicate the purchase price of goods, the parts being so constructed that a plurality of deposited checks may be at all times in view. The object is to provide a very simple and inexpensive construction.

ORE-WASHER.—F. H. Frankenberg, Pueblo, Col. In this instance the invention refers to improvements in machines for washing ores and similar substances, an object being to provide a washer of simple construction so arranged as to be operated with comparatively little power. A further object is to so construct the device that it may be placed and operated at the bottom of a dump, where there is no natural flow or pressure of water.

SHINGLE-SAWING MACHINE. — A. L. Shaw, Whitecastle, La. In this patent the invention has reference to improvements in shingle-sawing machines, in which the inventor aims to saw shingles rapidly and economically to the proper tapering shape and complete them in a smooth condition, so that they have the appearance of being planed, this end being obtained by cutting the bolt or billet of wood lengthwise of the grain.

CHANGEABLE-SPEED GEAR.—R. C. Killam, Faust, N. Y. The intention of Mr. Killam in this improvement is to provide a simple, compact, and durable form of changeable-speed gear wherein the desired change from high speed to low speed, and vice versa, may be easily and quickly effected by the adjustment of a single lever, which is placed within convenient reach of the operator.

Prime Movers and Their Accessories.

AUTOMATICALLY-REGULATED FEEDER FOR STEAM-BOILERS.—E. L. Del Castillo, Havana, Cuba. In this patent the invention has for its object the provision of novel features of construction and combination of parts for a water-feeding apparatus that positively and exactly controls the introduction of water into a steam-boiler so as to maintain the level of water therein at a predetermined height automatically.

ELECTRIC IGNITER FOR GAS-ENGINES.—E. Ford, Wilmington, Del. In this patent the improvement is in the nature of an electric igniter for gas and gasolene engines. It belongs to the class known as the "jump-spark" igniter and is automatic in its action. It consists in means whereby the electrodes are held in contact by a spring and are separated by the direct pneumatic pressure of the gases when they reach a certain degree of compression preparatory to explosion.

ROTARY EXPLOSIVE-ENGINE.—C. E. Shumway, Albion, Mich. In this case the invention bears relation to improvements in rotary engines operated by an explosive gas; and the aim is to provide an engine of this character of simple construction and of small dimensions, so that it may be conveniently used for the propulsion of vehicles.

PENDULUM-POWER. — A. T. Prather, Douglas, Arizona Ter. The aim of this inventor is to provide a new and improved pendulum-power more especially designed for use on marine vessels, land-vehicles, and the like, and arranged to utilize the swaying motion of the vehicle for actuating an air-pump or like motor.

Railways and Their Accessories.

DUMPING-CAR.—V. Kouns, Mokane, Mo. In this patent the invention relates to improvements in side-dumping cars, the purpose being to provide a means whereby all of the cars in a train may be simultaneously dumped, the dumping mechanism being operated from the locomotive, thus resulting in a saving of time in discharging train-loads.

AUTOMATIC RAILWAY-CAR OR WAGON COUPLING AND LOCKER.—W. Skerman, Brisbane, Queensland, Australia. The invention refers to car-couplings of the link-and-hook type, and aims to provide details of construction for the type indicated which adapt the coupling for an automatic coupled engagement with a similar coupling on a car moving on the same track toward the same, and which permit two couplings of the improved kind to be coupled together if positioned on cars at different heights from the track whereon the cars move. Furthermore, to afford convenient means for the manual detachment of standing or moving coupled cars.

AUTOMATIC CAR-STEP.—J. L. Hines, Dunn, N. C. In the present patent the inventor has reference to improvements in foldable steps for vehicles, the same being especially useful on railway passenger-cars in order that the adjustable step may be lowered for passengers to mount and dismount with ease and safety when the car is at rest.

DUMPING-CAR.—McKinley Boyle, New York, N. Y. An object in this case is to provide a two-way car in which continuous horse-arms are used in lieu of horse-chains, whereby there is no variation in the holding-points when the car-body is in normal position or at rest, thus making the arms superior to chains, because any shortening of one chain caused by kinking or otherwise will throw the whole upward tension of the body on the companion chain.

TROLLEY-FORK.—C. G. Hartman, Glens Falls, N. Y. The objects of the invention are to so construct the forks or harps as to prevent the working loose or falling out of the pin and doing away with the trouble and loss of time in changing and resetting trolley-wheels. Pins now in use are fastened with set-screws which require the use of tools in resetting them. Mr. Hartman avoids these objections, and sets and adjusts the pin without use of tools, set-screws, cotters, etc., in fifteen or twenty seconds.

DEVICE FOR AUTOMATICALLY OPERATING AIR-BRAKES.—T. H. Hillman, Spooner, Wis. This is an improvement in that class of automatic devices in which an adjustable contact-piece is arranged along the roadbed and is so adjusted as to be struck by a coacting member carried by the train, which member by coming in contact with the contact-piece in the road-bed is deflected and is made to open a valve in the train-pipe and release the air therein, so as to apply the brakes.

RAIL-TIE.—F. Gowen, Peabody, Kan. This device can be applied at any place along a track, can be used in soft or sandy roadbeds without sinking, will not require the use of many small articles to keep the track and rails in place, has no right or left hand parts, has no set-gear feature, requires only one tool to apply or remove it, can be removed and replaced without disturbing other ties or the rails, is adjustable to all sizes and kinds of rails and widths of tracks, does away with the use of fish-plates, and will be of even strength throughout its entire length.

PORTABLE WAITING-STATION.—C. U. Krieg, Sr., Nashville, Tenn. The object in this case is to provide a portable knockdown waiting-station for use of passengers on steam or electric railroads and which may also be used as a summer-house, telephone-station, or photograph-booth, the inventor's idea being to utilize it at the same time for purposes of advertisement by making the walls to subserve the double purposes of a protective inclosure and bulletin-boards.

Designs.

DESIGN FOR A TRIMMING.—S. Isaac, New York, N. Y. The design in this instance is a strip of material composed of figured bands five in number. The bands are spaced slightly apart and joined by corded loops, the open-work giving a pleasing ornamental effect.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 5814.—For makers of novelties.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 5815.—For makers of artificial ice machines, also for plant erectors.

Patented inventions of brass, bronze, composition or aluminum construction placed on market. Write to American Brass Foundry Co., Hyde Park, Mass.

Inquiry No. 5816.—For the makers of the stamping machine, for stamping on aluminium, called the "Simplex."

Inquiry No. 5817.—For makers of an ice cream freezer consisting of 6 or 8 individual cylinders.

Inquiry No. 5818.—For makers of tattooing machines, also supplies for tattooing.

Inquiry No. 5819.—For hand pumps capable of use to 40 pounds pressure, for air receiver.

Inquiry No. 5820.—For a good, serviceable, light-draft boat about 20 feet long, for use on the Mississippi River.

Inquiry No. 5821.—Wanted, a practical garbage crematory.

Inquiry No. 5822.—For manufacturers of the Haunted Swing.

Inquiry No. 5823.—For manufacturers of sad-irons or flat-irons which are heated by gasoline.

Inquiry No. 5824.—Wanted, a 3 h. p. marine boiler.

Inquiry No. 5825.—For manufacturers of pile drivers.

Inquiry No. 5826.—For makers of creosote shingles for roofing purposes.

Inquiry No. 5827.—For small fancy tassels made of paper, card, etc.

Inquiry No. 5828.—For parties to make to order stampings of wrought iron or soft steel plate, ⅜ inch thick.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9435) H. W. M. asks: 1. How many pounds of magnet wire are used in the making of an induction coil for one-inch spark? What numbers of wire are used on the primary and secondary coils? How thick is the core, and which is wound on first, the secondary or primary coil? Which is used—single silk-wound or double silk-wound wire? What is the lowest voltage that can be used and what is the highest voltage that can be used without injuring the coil? How many layers of primary and secondary wire are used, and how many wires long are they? A. An induction coil giving an inch spark can be made from 1¼ pounds No. 36 silk-covered copper wire, if properly wound. The primary may be No. 14 cotton-covered magnet wire wound in three layers. The core may be 7 inches long and ¾ inch in diameter. Single silk will doubtless answer for the covering, and double cotton. All wires are to be thoroughly saturated with paraffine. The primary is first wound, as its name implies. We would advise that you buy Norrie's "Induction Coils," which we can furnish for $1, and study the subject carefully, or you may waste costly material and get little for your pains, since you do not seem to have had much experience in such work. Q. How many men are equal to one horse-power, the men being of average weight? A. A man may be taken at from 1-10 to ⅛ of a horse-power for a day's work. For a few minutes a man can do more work than that.

(9436) A. P. G. asks: Several cells of dry battery were attached to a common electric bell, such as is used for door bells; the wire was then cut and the ends immersed in a dish of water, and the bell refused to work. Water being a conductor, why would it not carry the current and ring the bell? A. Water is not a good conductor of electricity, and there is no reason why an electric bell should ring when the wires are cut. Water is used as a resistance to prevent the flow of electricity in heavy currents. A water rheostat is a common device for this purpose. Thompson gives the resistance of pure water as more than a million times as great as that of copper. Ordinary water has not so great a resistance as this, but it has enough to prevent it from being classed as a conductor.

(9437) E. B. asks: Will you please inform we whether the south magnetic pole is of the same strength as the north magnetic pole? That is, is the earth the same as a bar magnet, having its two poles at the north and south magnetic? Also, when a ship is sailing south, before it crosses the magnetic equator is the compass affected by the north magnetic pole, and after crossing the magnetic equator is the compass then affected by the south magnetic pole? A. The location of the south magnetic pole of the earth has never been determined with precision. An expedition is now engaged in the effort to locate the north magnetic pole. It is prepared to be absent three years. We may on its return have definite knowledge concerning the matter. At present we can only say that the north magnetic pole is in British America, to the north of Hudson's Bay. The two magnetic poles are of the same strength. The earth behaves magnetically as if it had a bar magnet within it some 4,000 miles long, making an angle with its axis, and this magnet slowly oscillating, causing the declination of the needle. Both poles of this magnet attract and repel magnetic needles on the surface of the earth. This attraction and repulsion are not affected by the position of the compass. If it is in the northern hemisphere, the north pole attracts its north and repels its south end, and the south pole of the earth does the same. So also a compass in the southern hemisphere is affected by both the north and the south pole of the earth. The dip of a compass needle is affected by the pole to which it is nearer. In the northern hemisphere the north end of the needle dips, and in the southern hemisphere the south end of the needle dips, but the swinging of the needle in a horizontal plane is not caused by the pole of the hemisphere in which the needle is, to any greater extent than by the other pole of the earth.

NEW BOOKS, ETC.

POOR'S READY REFERENCE BOND LIST. Containing All Important Facts Required by Investors, Bond Experts, Bankers, and Others Relative to the Bonded Indebtedness, Interest Charges, etc., of the Leading Railroad Systems in the United States. New York: Poor's Railroad Manual Company, 1904. 8vo.; pp. 94. Price $2.

This is a supplement to Poor's Manual of Railroads. As the above descriptive title indicates, the pamphlet contains information of great value to the investor—information compiled directly from the official returns. The tabulation gives the following facts: The name of the company and description of bonds; the date of issue; the date of maturity; amount outstanding on or about December 1, 1903; annual charge and rate of interest, where payable, and when; the property covered; the amount of bonds outstanding per mile of road; and the trustees. There is an index, which makes any required bond in the table readily accessible.

THE LIGHTNING CONDUCTOR. The Strange Adventures of a Motor-Car. Edited by C. N. and A. M. Williamson. New York: Henry Holt & Co., 1903. 12mo.; pp. 344. Price $1.50.

While far from being a technically perfect novel, "The Lightning Conductor" more than makes up, in brightness, breeziness, and originality, for any defects in form. It is a capital story of romantic love pursued amid the ups and downs of an automobile trip through sunny France. There are masqueradings and misunderstandings, and the expected happy ending to it all. The writers seem to have aimed to do for modern life what Agnes and Egerton Castle have done for remoter times. They have certainly succeeded in investing the present with that glamor usually monopolized by the past. The incidental descriptions of scenery and architecture are happily worded, and convey vivid and pleasurable impressions to the mind of the reader.

HOW TO LIVE FOREVER. The Science and Practice. By Harry Gaze. Chicago: Stockman Publishing Company. 12mo.; pp. 205. Price $1.25.

While our inventors are experimenting with aeroplanes and motors, Mr. Gaze would solve the problem of aerial navigation simply by evolving wings from human shoulder-blades by auto-suggestion. This will serve to illustrate the extreme attitude of the writer, if the title of the work be not sufficient indication. There are many good rules, the observance of which would no doubt tend to prolong life; there is also some teaching which seems to us pernicious. As to the great problem which the author claims to have solved, most men, fond as they are of life, would agree with Stephen Phillips, when he makes Ulysses say,

"I would not take life save on terms of death,
That sting in the wine of being, salt of its feast."

THE HAYFIELD MOWER AND SCYTHE OF PROGRESS. By the Mower-Man. Volume I., Numbers 1 to 26. Boston: The Hayfield Mower, P. O. Box 1765, 1904. 8vo.; pp. 175. Price $1.25 net.

Nothing escapes the attacks of this Mower and Scythe. The snob, the hypocrite, the oppressor, have the feet cut from under them at every revolution of the wheels. The follies of our public school system, the dishonesty of our political system, and the injustice of our industrial system, all turn their worst sides for our inspection as the Mower lays them low. Although we may not always agree with the inexorable Mower-man as to what is or is not ripe for his determined assaults, yet we cannot fail to find a stimulation in watching him work. There is always a malicious pleasure to be taken in seeing the other fellow get his deserts; but when the Mower is in the field, we must choose our vantage ground with particular care. We advise the observer to wear cast-iron shoes, and to move quickly, otherwise he may get his own toes shaved by the knife.

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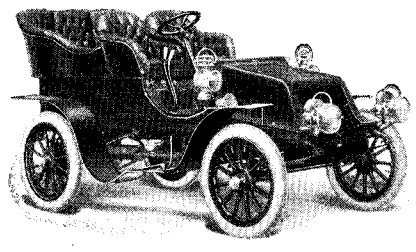

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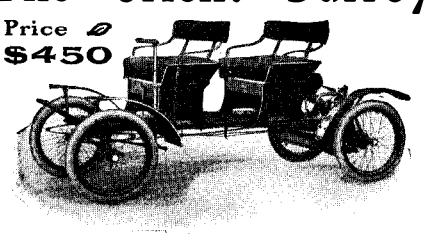

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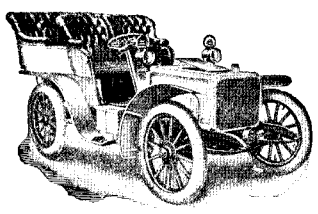

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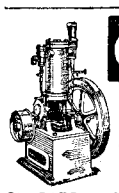

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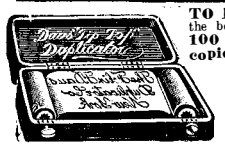

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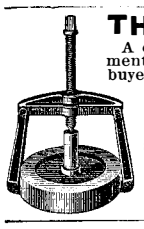

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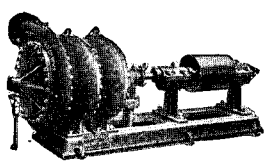

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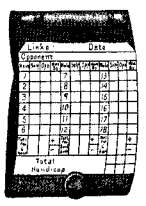

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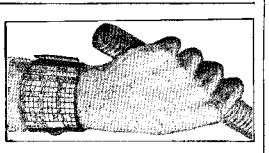

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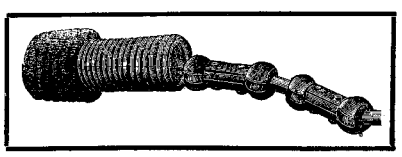

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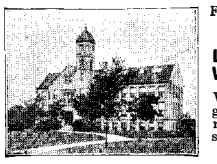

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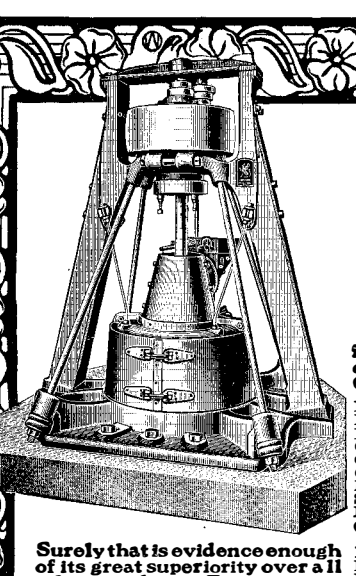

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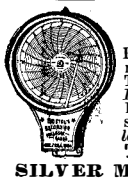

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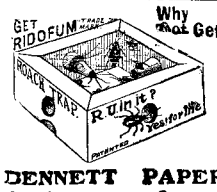

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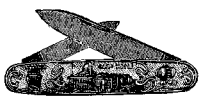

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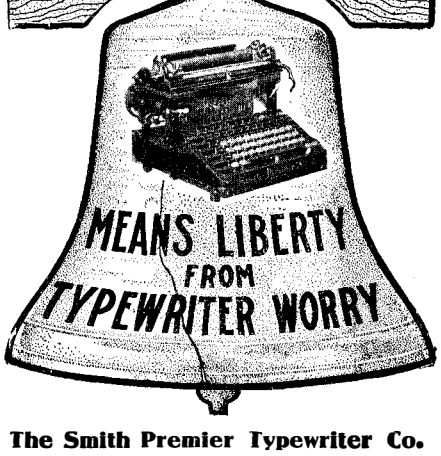

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